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State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

OCTOBER, 1831.

Description of an economical and delicate Balance; invented by Wm. Ritchie, *F. R. S. Communicated by* D. Strobel, *Esq., Civil Engineer.*

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir,—An economical, and at the same time very delicate, balance, for the determination of specific gravities, and the prosecution of chemical investigation in general, has hitherto, I believe, been deemed a desideratum;—under this impression, I send you the description of one, possessing these advantages in an eminent degree, and which, I have little doubt, will prove acceptable, if not useful, to many of your readers.

The instrument I am about to describe is the contrivance of a very learned and talented scientific gentleman, Mr. William Ritchie, M. A. F. R. S., whose acquaintance I had the pleasure to make, at Paris, in the year 1826, and is one amongst many other highly ingenious inventions of his, which he was kind enough to communicate to me.

The annexed sketch represents one of these balances—A, B, Fig. 1, is the beam, which is made of two slender pieces of any light sort of wood, sprung together at each end, and kept asunder in the middle by means of a wooden piece, C. These three pieces are to be well glued or otherwise securely fastened to each other. Through the end of each arm of the beam, and also through the centre of the piece C, is to be driven tight a small piece of hardened steel, formed like the straight part of an ordinary penknife blade, and of a length

sufficient to project on each side one-quarter or one-third of an inch. These blades, or knife edges, are to be fixed, as nearly as may be, equidistant from the centre, though any great nicety in this adjustment is quite unimportant, as we shall see presently. The edges of the blades should be situated nearly in the same horizontal plane, and must be elevated a little above the centre of gravity of the beam, for reasons which are too well known to be repeated here. The fulcrum of the balance rests upon two pieces of thermometer tube, each about half an inch in length, and drawn out in the flame of a lamp so as to reduce their diameter in the middle as shown at Fig. 2. These bits of tube are cemented with sealing wax into two grooves sunk in each side of a forked piece of wood, (see Fig. 3,) forming the upper extremity of a column, which serves as a stand for the instrument. The scale hooks are also formed of thermometer tube, and are represented at Fig. 4. Fig. 5 shows one of the knife edges.

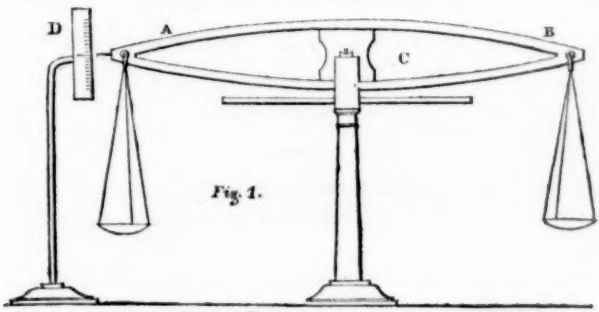


Fig. 1.

Fig. 2.

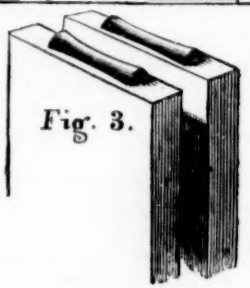


Fig. 3.

Fig. 4.

Fig. 5.

In using this balance for taking the specific gravity of bodies, or for any other purpose, we must always operate in the manner first pointed out, (if I recollect rightly,) by the Chevalier Borda; that is, the substance to be weighed is to be put into one of the scale pans and accurately counterpoised by means of small shot, metallic filings, &c. contained in the other; when this has been effected, the substance is to be removed from the scale, and its place supplied by known weights which are added until an equilibrium is obtained. By

operating in this manner, that perfect equality in the two arms of the lever, (so difficult to arrive at in practice,) becomes evidently of no moment, as has already been remarked in describing the instrument.

From the exceeding lightness of the beam, and the very small extent of touching surface between the knife edges and their glass supports at the points of contact, it will readily be conceded that the friction must necessarily be less than in balances of the ordinary construction; its accuracy will be therefore superior, whilst it may probably be constructed, in most places, for the hundredth part of their cost.

In conclusion, it will perhaps be proper to observe, that in operating with this instrument, when it has been properly adjusted, it will be found to vibrate for a very considerable time before coming to rest; an additional proof of its great delicacy, but which, on most occasions, would be found rather tedious: to obviate this inconvenience, the ingenious inventor inserted in the end, A, of the beam, (Fig. 1,) a common sewing needle, which, when the beam was in a horizontal position, pointed towards the middle of a small piece of pasteboard, D, whereon was traced a number of equi-distant lines, the spaces between which, for distinction sake, I shall call *degrees:* The middle division was marked zero, and the others 1, 2, 3, &c., increasing from zero both upwards and downwards. This piece of pasteboard was affixed to a small stand, as shown in the drawing. The following is Mr. Ritchie's method of using this apparatus; after the substance has been counterpoised, the beam must be suffered to vibrate, and the number of degrees through which the needle passes, both above and below zero, be noted; we must then remove the substance and substitute weights in its stead, until the needle vibrates between the identical divisions it previously did; by this means we get rid of the inconvenience above alluded to, and arrive at results equally accurate with those we should have obtained by suffering the beam to come to rest.

I am, sir, very respectfully,
Your most obedient servant,
D. STROBEL, Jr.

New York, September 1st, 1831. *Engineer.*

Note.—One of the above described balances was compared, in the laboratory of Gay Lussac, with those made by the most eminent workmen, and was found to equal them in sensibility and accuracy. —EDITOR.

A description of Thorp's improved Running Cap Spinner, with a drawing showing its proper construction for spinning into a shuttle bobbin. Published by request of the patentee.

AT page 388, vol. vi. we inserted a specification of a patent for improvements on the running cap spinner, accompanied by drawings. It was the design of Mr. Thorp to have had an engraving of the spindle as now presented, on the plate which accompanied his specification, but the drawing was not received until too late for the

engraver: we have therefore had the present cut made to remedy this omission.

Thorp's Running Cap Spinner.

A, is a tunnel formed of sheet iron, brass, tin, or any other suitable substance. Its nosle is generally made of an equal diameter throughout, although this is not absolutely necessary. The cavity of said nosle ought to be no longer than is sufficient to allow the body of the bobbin to traverse up into it without interference.

It is supported at the top of the spindle by a conical socket which suits the taper of the spindle, and is held down to its place by a pin which passes entirely through said nosle, occupying a part of its conical hollow. One side of the tapered part of the spindle is scarfed off so as to allow the pin and nosle to go down to a proper bearing, and is there held by an oblique or horizontal notch, which is formed in one side of said scarf level, with the pin, and in which the pin hitches. The diameter of the brim of the tunnel should be considerably larger than that of the bobbin or roll of yarn, so as to admit the check within the brim, without interfering with the bobbin or yarn. B, is the roll of yarn on the bobbin. C is a conical spiral spring used for the purpose of allowing the bobbin to be pressed down when piercing the yarn. The upper end of this spring is confined to a thin plate of sheet iron, brass, or tin. Said plate is a small size larger than the head or base of the bobbin, so as to be taken hold of without interfering with the bobbin. This plate is perforated in the centre, and loosely encompasses the spindle. It has a tube extending up into the bobbin a short distance, or it may be made dishing, so that the base of the bobbin which sets on it, will find a sufficient friction from which to receive motion. In case of piercing the yarn when the bobbin is at its highest elevation, the plate is taken hold of and pressed down for that purpose. The lower end of the spring is confined to the thimble D, which thimble supplies the place of the collar described in the former publication, to which reference may be had. E, is the box that forms the upper bearing of the spindle. G, the check. F, the lifter on which the above named thimble sets.

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, to ascertain, by experiment, the value of Water as a Moving Power.

(Continued from p. 153.)

TABLE G.—PART 1.

CHUTE No. 3.—*Elbow buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Experi.	Head of Water above. Bttm. of gate.	Top of Bkt.	Bttm. of Bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W'of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	9.34	11.27	12.56	0.50	463	48.05	511.05	41.5	30	13.02	2350	23.00	540500	212085	.392			
2					669	51.61	720.61		33	11.84	2820		648600	299053	.460			
3					772	53.39	825.39		35	11.16	3100		713000	342536	.480			
4					875	55.17	930.17		44	9.88	3475		799250	386020	.484			
5					978	56.95	1034.95		45	8.70	3770		867100	429504	.494	.494	8.70	
6					1081	58.73	1139.73		52	7.52	4200		966000	472987	.489			
7					1184	60.51	1244.51		56	6.98	4700		1081000	516471	.477			
8					1287	64.88	1351.88		63	6.20	5200		1196000	561030	.469			
9					1390	69.25	1459.25		63	6.20	5640		1297200	605588	.466			
10					1493	73.62	1566.62		65	6.01	6000		1380000	650146	.471			
11					1596	77.99	1673.99		69	5.66	6425		1477750	694705	.463			
2					1699	82.36	1781.36		80	4.88	7200		1656000	739263	.447			
13	9.34	11.27	12.56	0.75	772	53.39	825.39	41.5	27	14.48	3325	23.00	764750	342536	.447			
14					875	55.17	930.17		30	13.02	3525		810750	386020	.475			
15					978	56.95	1034.95		33	11.84	3850		885500	429504	.487			
16					1081	58.73	1139.73		35	11.16	4075		937250	472987	.504			
17					1184	60.51	1244.51		40	9.77	4425		1017750	516471	.507			
18					1287	64.88	1357.88		41	9.54	4780		1099400	561030	.510			
19					1390	69.25	1459.25		44	8.88	5140		1182200	605588	.512	.512	8.88	
20					1493	73.62	1566.62		47	8.32	5585		1284550	650146	.505			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table G.—Part II.

Chute No. 3.—*Elbow buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above. Btm. of gate.	Head of water above. Top of bkt.	Head of water above. Btm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt.of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
21	9.34	11.27	12.56	0.75	1596	77.99	1673.99	41.5	53	7.38	6100	23.00	1403000	694705	.495			
22					1699	82.36	1781.36		56	6.98	6575		1512250	739263	.488			
23					1802	86.73	1888.73		57	6.86	7100		1633000	783823	.485			
24					1905	91.10	1996.10		63	6.20	7520		1729600	828381	.472			
25					2008	95.47	2103.47		68	5.76	8100		1863000	872939	.467			
26					2111	99.84	2210.84		73	5.35	8625		1983750	917498	.456			
27					2214	104.21	2318.21		80	4.88	9375		2156250	962056	.446			
28	7.09	9.02	10.31	0.50	463	48.05	511.05	41.5	30	13.02	2400	20.75	498000	212085	.425			
29					566	49.83	615.83		32	12.20	2670		554025	255569	.461			
30					669	51.61	720.61		38	10.28	2910		603825	299053	.495			
31					772	53.39	825.39		43	9.09	3220		688150	342536	.509			
32					875	55.17	930.17		47	8.32	3575		741312	386020	.520	.520	8.32	
33					978	56.95	1034.95		56	6.98	4035		837262	429504	.513			
34					1081	58.73	1139.73		63	6.20	4550		944125	472987	.500			
35					1184	60.51	1244.51		67	5.84	5025		1042687	516471	.495			
36					1287	64.88	1351.88		72	5.43	5525		1156437	561030	.485			
37					1390	69.25	1459.25		80	4.88	6100		1265750	605588	.478			
38					1493	73.62	1566.62		90	4.34	6700		1390250	650146	.467			
39					1699	82.36	1781.36		103	3.79	7700		1597750	739263	.462			
40					1905	91.10	1996.10		112	3.49	8860		1838450	828381	.450			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE G.—PART III.

CHUTE No. 3.—*Elbow buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Expt.	Head of water above. Bttm. of gate.	Head of water above. Top of bkt.	Head of water above. Bttm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W'tofwater expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
41	7.09	9.02	10.31	0.75	978	56.95	1034.95	41.5	36	10.86	3920	20.75	813400	429504	.527			
42					1081	58.73	1139.73		38	10.28	4175		866312	472987	.546			
43					1184	60.51	1244.51		41	9.53	4530		939975	516471	.549	.549	9.53	
44					1287	64.88	1351.88		46	8.50	4975		1032312	561030	.543			
45					1390	69.25	1459.25		50	7.82	5475		1136062	605588	.533			
46					1493	73.62	1566.62		53	7.37	5975		1239813	650146	.524			
47					1596	77.99	1673.99		58	6.73	6400		1328000	694705	.523			
48					1699	82.36	1781.36		60	6.51	6930		1438975	739263	.513			
49					1802	86.73	1888.73		67	5.83	7450		1545875	783823	.506			
50					1905	91.10	1996.10		74	5.28	8050		1670375	828381	.495			
51					2008	95.47	2103.47		82	4.77	8700		1805250	872939	.483			
52					2111	99.84	2210.84		86	4.54	9228		1914187	917498	.479			
53	7.09	9.02	10.31	1.00	1081	58.73	1139.73	41.5	31	12.60	4350	20.75	902625	472987	.527			
54					1184	60.51	1244.51		32	11.84	4650		964870	516471	.535			
55					1287	64.88	1351.88		36	10.86	5000		1037500	561030	.541			
56					1390	69.25	1459.25		38	10.28	5350		1110125	605588	.545			
57					1493	73.62	1566.62		40	9.77	5675		1177562	650146	.551			
58					1596	77.99	1673.99		43	9.09	6025		1250187	694705	.555	.555	9.09	
59					1699	82.36	1781.36		45	8.69	6475		1343562	739263	.550			
60					1802	86.73	1888.73		51	7.66	7000		1452500	783823	.539			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE G.—PART IV.

CHUTE No. 3.—*Elbow buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt.of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
61	4.09	6.02	7.31	0.50	566	49.83	615.83	41.5	40	9.77	2775	17.75	481687	255569	.530			
62					772	53.39	825.39		53	7.38	3475		616812	342536	.555	.555	7.38	
63					875	55.17	930.17		63	6.20	3975		705562	386020	.546			
64					978	56.95	1034.95		70	5.58	4460		791650	429504	.542			
65					1081	58.73	1139.73		75	5.21	4900		869750	472987	.543			
66					1184	60.51	1244.51		83	4.71	5400		958500	516471	.539			
67					1287	64.88	1351.88		100	3.91	6025		1069437	561030	.524			
68					1390	69.25	1459.25		102	3.83	6550		1162625	605588	.524			
69					1493	73.62	1566.62		109	3.59	7025		1246937	650146	.521			
70	4.09	6.02	7.31	0.75	669	51.61	720.61	41.5	37	10.56	3150	17.75	559125	299053	.534			
71					772	53.39	825.39		39	10.02	3450		612375	342536	.559			
72					875	55.17	930.17		42	9.31	3725		661187	386020	.584			
73					978	56.95	1034.95		45	8.70	4075		723312	429504	.593			
74					1081	58.73	1139.73		51	7.66	4450		789875	472987	.598			
75					1184	60.51	1244.51		51	7.66	4800		852000	516471	.606	.606	7.66	
76					1287	64.88	1351.88		62	6.30	5350		949625	561030	.590			
77					1390	69.25	1459.25		65	6.00	5800		1029500	605588	.588			
78					1493	73.62	1566.62		73	5.35	6400		1136000	650146	.574			
79					1596	77.99	1673.99		77	5.07	6950		1233625	694705	.562			
80					1699	82.36	1781.36		83	4.71	7500		1331250	739263	.555			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table G.—Part V.

Chute No. 3.—*Elbow buckets. Close breast. Bottom of gate 13.66 feet above bottom of wheel.*

No. of Expt's.	Head of water above. Btm. of gate.	Top of bkt.	Btm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt. of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.						
81	4.09	6.02	7.31	1.00	875	55.17	930.17	41.5	36	10.86	3800	17.75	674500	386020	.572			
82					978	56.95	1034.95		38	10.28	4125		732187	429504	.586			
83					1081	58.73	1139.73		42	9.31	4500		798750	472987	.591			
84					1184	60.51	1244.51		43	9.09	4825		856437	516471	.603			
85					1287	64.88	1351.88		47	8.32	5225		927437	561030	.605	.605	8.32	
86					1390	69.25	1459.25		52	7.52	5700		1011750	605588	.598			
87					1493	73.62	1566.62		57	6.85	6225		1104937	650147	.588			
88					1596	77.99	1673.99		60	6.50	6650		1180375	694705	.588			
89					1802	86.73	1888.73		71	5.50	7725		1371187	783822	.571			
90					2008	95.47	2103.47		82	4.77	8900		1579750	872939	.552			
91	1.09	3.02	4.31	0.75	566	49.83	615.83	41.5	49	7.98	2850	14.75	420375	255569	.608			
92					669	51.61	720.61		62	6.30	3250		479375	299053	.624			
93					772	53.39	825.39		64	6.10	3650		538375	342536	.636	.636	6.10	
94					875	55.17	930.17		73	5.35	4150		612125	386020	.630			
95					978	56.95	1034.95		81	4.83	4650		685875	429504	.626			
96					1081	58.73	1139.73		87	4.49	5175		763312	472987	.619			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE G.—PART VI.

CHUTE No. 3.—*Elbow buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W't of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1	Maximum effect.	Velocity at maximum.	Observations.
	Bim. of gate.	Top of bkt.	Bun. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
97	1.09	3.02	4.31	1.00	772	53.39	825.39	41.5	51	7.66	3675	14.75	542062	342536	.631			
98					875	55.17	930.17		61	6.40	4100		604750	386020	.638			
99					978	56.95	1034.95		62	6.30	4500		663750	429504	.647	.647	6.30	
100					1081	58.73	1139.73		70	5.58	5000		737500	472987	.641			
101					1184	60.51	1244.51		81	4.83	5500		811250	516471	.636			
102					1287	64.88	1351.88		88	4.44	6000		885000	561030	.633			
103					1390	69.25	1459.25		90	4.35	6500		958750	605588	.631			
104	1.09	3.02	4.31	1.25	1081	58.73	1139.73	41.5	60	6.50	4900	14.75	722750	472987	.654			
105					1184	60.51	1244.51		63	6.20	5325		785437	516471	.657			
106					1287	64.88	1351.88		69	5.66	5775		851812	561030	.658	.658	5.66	
107					1390	69.25	1459.25		74	5.28	6325		932937	605588	.649			
108					1493	73.62	1566.62		82	4.77	6875		1014062	650147	.641			
109					1596	77.99	1673.99		90	4.35	7375		1087812	694705	.641			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE II.—PART I.

[CHUTE No. 3.—*Centre buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W't of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	9.34	11.27	12.56	0.50	669	51.61	720.61	41.5	39	10.02	3000	23.00	690000	299053	.433			
2					772	53.39	825.39		42	9.31	3275		753250	342536	.454			
3					875	55.17	930.17		46	8.50	3625		833750	386020	.462	.462	8.50	
4					978	56.95	1034.95		49	7.98	4085		939550	429504	.457			
5	9.34	11.27	12.56	0.75	669	51.61	720.61	41.5	27	14.48	3200	23.00	736000	299053	.406			
6					875	55.17	930.17		34	11.50	3625		833750	386020	.462			
7					1081	58.73	1139.73		36	10.86	4250		977500	472987	.484	.484	10.86	
8					1184	60.51	1244.51		41	9.54	4650		1069500	516471	.483			
9					1287	64.88	1351.88		45	8.71	5075		1167250	561030	.480			
10					1390	69.25	1459.25		50	7.82	5600		1288000	605588	.470			
11					1493	73.62	1566.62		60	6.50	6235		1434050	650146	.453			
12	9.34	11.27	12.56	1.00	1493	73.62	1566.62	41.5	40	9.77	5575	23.00	1282250	650147	.507	.507	9.77	
13					1596	77.99	1673.99		42	9.31	6050		1391500	694705	.499			
14	7.09	9.02	10.31	0.50	566	49.83	615.83	41.5	40	9.77	2800	20.75	581000	255569	.436			
15					669	51.61	720.61		43	9.09	3125		648437	299053	.451			
16					772	53.39	825.39		48	8.14	3475		721062	342536	.475	.475	8.14	
17					875	55.17	930.17		56	6.98	3930		815475	386020	.472			
18					978	56.95	1034.95		61	6.40	4400		913000	429504	.470			
19					1081	58.73	1139.73		69	6.66	4900		1016750	472987	.465			
20					1184	60.51	1244.51		75	5.21	5535		1148512	516471	.449			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE H.—PART II.

CHUTE No. 3.—*Centre buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above. Btm. of gate.	Head of water above. Top of bkt.	Head of water above. Btm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio. power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
21	7.09	9.02	10.31	0.75	875	55.17	930.17	41.5	36	10.86	3800	20.75	788500	386020	.489			
22					978	56.95	1034.95		38	10.28	4110		852825	429504	.503			
23					1081	58.73	1139.73		43	9.09	4500		933750	472987	.506	.506	9.09	
24					1184	60.51	1244.51		51	7.66	4975		1032312	516471	.500			
25					1287	64.88	1351.88		63	6.20	5725		1187937	561030	.472			
26	7.09	9.02	10.31	1.00	1081	58.73	1139.73	41.5	35	11.16	4435	20.75	920262	472987	.514			
27	"	"	"	"	1184	60.51	1244.51	"	39	10.02	4800	"	996000	516471	.518			
28					1287	64.88	1351.88		43	9.09	5225		1084187	561030	.517			
29					1390	69.25	1459.25		46	8.50	5575		1156812	605588	.523	.523	8.50	
30					1493	73.62	1566.62		50	7.82	6225		1291687	650147	.503			
31					1596	77.99	1673.99		56	6.98	6725		1395437	694705	.498			
32	4.09	6.02	7.31	0.75	978	56.95	1034.95	41.5	50	7.82	4425	17.75	785437	429504	.547	.547	7.82	
33					1081	58.73	1139.73		54	7.23	4895		868862	472987	.542			
34					1184	60.51	1244.51		66	5.92	5475		971812	516471	.531			
35					1287	64.88	1351.88		73	5.35	6125		1087187	561030	.516			
36					1390	69.25	1459.25		78	5.01	6675		1184812	605588	.511			
37	4.09	6.02	7.31	1.00	1081	58.73	1139.73	41.5	45	8.69	4710	17.75	836025	472987	.561			
38					1184	60.51	1244.51		50	7.82	5125		909687	516471	.567	.567	7.82	
39					1287	64.88	1351.88		52	7.51	5600		994000	561030	.564			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table H.—Part III.

Chute No. 3.—*Centre buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of Water above.			Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Btm. of gate.	Top of bkt.	Btm. of bkt.															
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.						
40	1.09	3.02	4.31	1.00	669	51.61	720.61	41.5	54	7.23	3600	14.75	531000	299053	.563			
41					772	53.39	825.39		63	6.20	4025		593687	342536	.576			
42					875	55.17	930.17		69	5.66	4450		656375	386020	.588	.588	5.66	
43					978	56.95	1034.95		77	5.07	4950		730125	429504	.588			
44					1081	58.73	1139.73		88	4.44	5500		811250	472987	.583			
45					1184	60.51	1244.51		92	4.24	6025		888678	516471	.581			
46	1.09	3.02	4.31	1.25	978	56.95	1034.95	41.5	44	8.88	4975	14.75	733812	429504	.585			
47					1081	58.73	1139.73		49	7.98	5435		801662	472987	.589			
48					1184	60.51	1244.51		52	7.51	5835		860662	516471	.600			
49					1287	64.88	1351.88		56	6.98	6275		925562	561030	.606			
50					1390	69.25	1459.25		62	6.30	6750		995625	605588	.607			
51					1493	73.62	1566.62		66	5.92	7250		1069375	650147	.608			
52					1596	77.99	1673.99		68	5.75	7625		1124687	694705	.617	.617	5.75	
53					1699	82.36	1781.36		71	5.50	8125		1198437	739263	.616			
54					1802	86.73	1888.73		80	4.88	8750		1290625	783822	.607			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE H.—PART IV.

CHUTE No. 3.—*Centre buckets. Close breast. Bottom of gate* 13.66 *feet above bottom of wheel.*

No. of Exper't.	Head of water above. Bttm. of gate	Top of bkt.	Bttm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height Raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
55	1.09	3.02	4.31	1.50	1596	77.99	1673.99	41.5	64	6.10	7600	14.75	1121000	694705	.619			
56					1699	82.36	1781.36		66	5.92	8050		1187375	739263	.624			
57					1802	86.73	1888.73		69	5.66	8475		1250062	783822	.627	.627	5.66	
58					1905	91.10	1996.10		74	5.28	9025		1331187	828381	.622			
59					2008	95.47	2103.47		79	4.95	9725		1434437	872939	.608			
60	1.09	3.02	4.31	1.75	1699	82.36	1781.36	41.5	59	6.62	8030	14.75	1184425	739263	.624			
61					1802	86.73	1888.73		64	6.10	8460		1247850	783822	.628	.628	6.10	
62					1905	91.10	1996.10		67	5.83	9000		1327500	828381	.624			
63					2008	95.47	2103.47		72	5.43	9600		1416000	872939	.616			
64					2111	99.84	2210.84		77	5.07	10330		1523675	917498	.602			
65	4.09	6.02	7.31	1.00	1184	60.51	1244.51	41.5	44	8.88	4925	17.75	874187	516471	.590			
66					1287	44.88	1351.88		47	8.31	5300		940750	561030	.596			
67					1390	69.25	1459.25		51	7.66	5700		1011750	605588	.598	.598	7.66	
68					1493	73.62	1566.62		56	6.98	6160		1093400	650147	.594			Air vents open.
69					1596	77.99	1673.99		61	6.40	6625		1175937	694705	.590			
70					1802	86.73	1888.73		69	5.66	7650		1357875	783822	.577			
71					2008	95.47	2103.47		90	4.34	8650		1535375	872939	.568			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

(TO BE CONTINUED.)

Proposed plan for Smelting Iron Ore with Anthracite Coal.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

The annexed communication was received from an unknown correspondent, and we have concluded to insert it in our journal, as it relates to a subject which we deem of the highest importance; we are not disposed to place much reliance, *a priori*, upon the value of his suggestions, as some of them are new and untried; but we are open to conviction as to their utility;—others we know to be erroneous. The writer has, we think, overrated the advantages of the water blast. That it produces a cheap and uniform blast is unquestionable, but the air which issues from it is so saturated with moisture as to occasion an increased expenditure of fuel, which more than counterbalances any advantages resulting from the cheapness and facility of construction, besides occasioning very serious inconveniencies in those furnaces in which the highest temperature is desirable. As to his suggestion of introducing a small jet of steam, we must be permitted to question its advantages; the experiment was tried many years since, in England, and failed. See Jour. Arts and Manuf. iv. 235, quoted in Hassenfratz's Siderotechnie, ii. 180. We invite the attention of our readers and correspondents to the importance of devising a mode of applying anthracite to the smelting of iron ore.

Com. Pub.

On the top of a reverberatory furnace, build a vertical furnace, with its lower extremity, or crucible, connected with the lower furnace, in such a manner that the hearth of the lower furnace shall serve for the hearth of the upper furnace also. The shape of the upper furnace may be similar to the common blast furnace, and its height about the same as the length of the lower furnace. The top of the upper furnace must not be open like the common blast furnace, but covered, and connected by a flue to the chimney of the lower furnace.

There must be an opening near the top of the upper furnace, for the introduction of the coal and ore, which must be kept closed, so that no air can enter, only through openings made for that purpose near the bottom of the furnace, in order to supply air for combustion. The flues of the furnaces must be connected and turned horizontally and inserted into a water blast, or *trompe*, (for the manner of constructing which, see Rees' Cyclopædia—article, water-bellows; and also in the Chemistry of the Arts, published by Porter, 1830, p. 57 and 58, there is an account given of its producing a very powerful draught of air through a furnace.) The reverberatory furnace must first be raised to a sufficient degree of heat; then the upper furnace charged with coal and ore: as the one melts it drops from the crucible of the upper furnace into the hearth of the lower furnace, where it will be kept fluid, until sufficient is collected to be drawn off. It is believed that a sufficient flame may be produced from anthracite coal to heat the reverberatory furnace, by introducing a small jet of

steam, as has been done by the Messrs. Wetherells, of Philadelphia. If bituminous coal were used in the lower furnace, it would probably not affect the quality of the iron, as it would be always covered with fluid cinders.

The author of these suggestions melted iron ore very easily, in a small air furnace with anthracite coal, the only difficulty met with was, that the metal chilled on the hearth of the furnace. If, in this experiment, there had been means of keeping the melted metal fluid, the ore might have been smelted very fast, on a small scale, as there was no difficulty in keeping up a sufficient degree of heat to melt the ore in the furnace, above the *tuyere*, or opening, for the ingress of the air. The result of this experiment, and a knowledge of the fact, that a very powerful air draught may be obtained by the mode above referred to, (viz. the water-draught,) and a belief that a blast given by bellows is not so conducive to the rapid combustion of anthracite coal, as a more uniform and general blast, has induced me to make these suggestions to those who feel a sufficient interest to make experiments, in order to accomplish so important an object.

A. B.

Lebanon, Penn., August, 1831.

On Blasting Rocks. By Robert Hare, *M. D., Professor of Chemistry in the University of Pennsylvania.*

An account has lately been published of the death of a workman, near Norristown, dreadfully bruised, and lacerated, by the blasting of a rock. I have ascertained that the process for blasting rocks may be rendered safer than the firing of a fowling piece, by a new application of galvanism. I was led to make this improvement in consequence of an application by a patentee, (Mr. Moses Shaw,) for assistance in perfecting his patented mode of blasting rocks by an electric discharge from a Leyden Jar.

In a letter dated June 1st, 1831, he says, "I have been engaged in blasting rocks by means of a fulminating powder, introduced into several cavities, and ignited in all of them simultaneously, by a spark from an electrical machine, by which means masses of a much larger size, and of a much more suitable shape, for any object in view, may be procured, than by the old plan. I have, however, to lament my inability to succeed in this method of blasting during a great part of the year, when, in consequence of the unfavourable state of the weather, the ignition cannot be effected by electricity in any mode which I have devised, or which has been suggested by others, although I have consulted all the best informed professors to whom I have had access."

It occurred to me as soon as this statement had been made by Mr. Shaw, that the ignition of gunpowder, for the purposes he had in view, might be effected by a galvanic discharge from a deflagrator, or calorimotor, in a mode which I have long used in my eudiometrical experiments to ignite explosive gaseous mixtures. This process is free

from the uncertainty which is always more or less attendant upon the employment of mechanical electricity for similar purposes.

The expectation thus arising has since been fully verified. I have ignited as many as twelve charges of gunpowder at the distance of one hundred and thirty feet from the galvanic machine employed. This distance is much greater than is necessary to the safety of the operator, as the deflagrator may be shielded so as not to be injured by the explosion, and by means of levers and pulleys, it may be made to act at any distance which may be preferable. There is no limit to the number of charges which may be thus ignited, excepting those assigned, by economy, to the size of the apparatus employed.

These remarks have reference to the principal and highly important object of Mr. Shaw's project, which is, to ignite at once a great number of charges in as many perforations so drilled in a rock as to co-operate simultaneously in the same plan. By these means it is conceived that the stone may be separated into large prismatic or tabular masses, instead of being reduced to irregular fragments of an inferior size. The object to which I propose now to call attention more particularly is, a modification of the common process of blasting by one charge, which renders that process perfectly safe.

This part of the subject I shall introduce by premising that almost all the accidents which have taken place in blasting rocks, have occurred in one of the three following modes:

1st. The explosion has taken place prematurely, before the operator has had time to retire.

2nd. A premature explosion has ensued from a spark produced by the collision arising from ramming into the orifice of the perforation, containing the powder, the brickdust or sand employed to close it.

3d. The fire not reaching the charge after the expiration of a period unusually long, and the operator returning to ascertain the cause of the supposed failure, an explosion ensues when he is so near as to suffer by it, as in the instance near Norristown, lately published.

The means of communicating ignition, to which I have resorted, are as follows:—

Three iron wires, of which one is of the smallest size used for wire gauze, the others of the size, (No. 24,) used by bottlers, are firmly twisted together. This is best accomplished by attaching them to the centre of the mandril of a lathe, which is made to revolve while the other ends of the wires are held by a vice, so as to keep them in a proper state of tension. After being thus twisted, a small portion is untwisted, so as to get at, and divide, the larger wires by means of a pair of nippers. In this way the smaller wire is rendered the sole mean of metallic connexion between the larger ones. These are tied in a saw kerf, so made in a piece of dogwood as to secure them from working, which, if permitted, would cause the smaller wire to break apart. At one end, the twist formed of the wires is soldered to the bottom of a tin tube of a size to fill the perforation in the rock to such a height as may be deemed proper. This tube being supplied with gunpowder, the orifice is closed with a cork, perforated

so that the twisted wire may pass out through it without touching the tube at any point above that where the finer portion alone intervenes. To the outside of the tube a copper wire, about No. 16, is soldered, long enough to extend to a copper, or leaden, rod proceeding from one of the poles of a galvanic deflagrator, or calorimotor. The wire passing through the cork, from the inside of the tube, is in like manner made to communicate with the other pole. The connexions between the wires, rods and poles, should be made by means of soft solder, previously to which we must imagine that the tube has been introduced into a perforation made for its reception in a rock to be blasted. The tin tube may be secured within the rock by the usual method of ramming in brickdust or sand, by means of a punch, having holes for the protection of the wires of communication already described.

The apparatus being thus prepared, by a galvanic discharge, produced by the movement of a lever through a quarter part of a circle, the finer wire is ignited, in the place where it intervenes solely in the circuit, so as to set fire to the surrounding gunpowder.

As the enclosure of the gunpowder in the tube must render it impossible that it should be affected by a spark elicited by ramming, as no means of ignition can have access to the charge besides the galvanic discharge; and as this can only occur by design, with an intention to commit murder or suicide, or from unpardonable neglect, it is inconceivable that an explosion can take place in this method of blasting, when any person is so situated as to suffer by it.

It must be obvious that in all cases of blasting under water, the plan of the tin tube, and ignition by a galvanic circuit must be very eligible.

I hope Mr. Shaw may meet with the patronage which his project merits.

ROBT. HARE.

FRANKLIN INSTITUTE.

Explosions of Steam Boilers.

THE committee appointed to investigate the causes of explosions in steam boilers have had the subject under consideration for some time; and have pursued with as much diligence as possible the course of experiments instituted with a view to shed light on this question. These experiments require much nicety and care; and the members of the committee are all so much occupied in their own private business that the inquiry is necessarily protracted. Some of the results which they have already obtained, they believe to be curious, and they will not fail in due time to lay them before the public. Their present intention is to communicate a portion of the letters which they have received. Although the replies to their circular have not been so numerous and detailed as they might wish, yet the committee have been favoured with many very interesting communica-

tions which they believe it would be an act of injustice to their authors longer to withhold from the public.

Independently of the general information which they are calculated to give, the circulation of these letters may be productive of other advantages. By publishing the opinions of able and intelligent observers, the committee hope to elicit a discussion of them by others. Such a discussion cannot fail to enlighten us still more on the numerous causes of the accidents which have occurred.

The committee, moreover, are under the impression that many acute and intelligent observers have been, from an excess of diffidence as to their talents for writing, induced to suppress their communications. Perhaps, after seeing the nature of the information required, they may feel disposed to contribute their share to the general stock. Facts, plainly and clearly stated, are the most valuable contribution which can be made; and there is scarcely a practical mechanic on our western waters who may not be able to communicate something that has escaped the attention of others. If any letters should come in a form not exactly fitted for publication, the committee would, with the permission of their authors, revise them with that view.

To avoid any appearance of partiality, the committee have determined to publish these letters in the order of their date, but they have been induced occasionally to deviate from this rule, so as to group together such as refer to the same accident. By exhibiting the views of different writers upon the same explosion, in one continued series, it will be easier to come at the truth as to its real cause. Thus, for example, in relation to the Helen M'Gregor and Caledonia, the committee will have the pleasure of presenting, in the next number, several letters which mutually confirm each other.

In order to collect all that bears upon that investigation, the committee are induced to commence their publication with the reprint of a very interesting pamphlet published many years since in this city, but which has now become very scarce. For the copy which is in their possession, the committee are under obligations to Roberts Vaux, Esq. the chairman of the committee of councils to whom this matter was at that time referred.

1. Report of the Joint Committee appointed by the Select and Common Councils, on the subject of Steam Boats.

The joint committee of the select and common councils appointed to consider "*whether any, and if any, what, regulations can be enforced in relation to the use of steam, employed in propelling boats for the accommodation of passengers, which arrive at, and depart from, the wharves within the jurisdiction of the corporation:*" and also, (should it be necessary,) "*to prepare a memorial to the legislature of the state, soliciting its interposition, effectually to control the use of steam in passage boats,*" Report:

That, sensible of the importance of the duty assigned them, they have devoted much time and attention to the investigation. They have availed themselves of the learning and experience of scientific

characters, whose prompt, candid, and able illustrations and advice on the subject, are entitled to acknowledgments which the committee take pleasure in rendering for themselves, and on behalf of their constituents.

Convinced by the notorious and afflicting fact, that *human life* had been frequently destroyed in consequence of the bursting of the boilers of steam engines, used in navigating boats, it became a prominent and interesting question with the committee, *whether any, and what effectual mode could be adopted to prevent such explosion.* To the gentlemen previously alluded to, the inquiry was submitted. Their opinion of the necessity of legal interference, with a plan for testing the strength of boilers, and contemplating the attachment to them of safety valves, to be placed beyond the reach of the caprice or temerity of engineers, being furnished, it was with a circular note transmitted to the proprietors of those steam boats which pass upon the Delaware, and accompanies this report, numbered 1.

A disposition to acquiesce in the regulations and precautions, thus suggested, was manifested by the persons to whom they were proposed; but it was alleged by some of them, that their adoption would not provide against *all* the casualties incident to the management of steam engines which might produce explosion. It was represented, that the plan was calculated to give unjustifiable confidence to the public, that thereby the use of *high steam* would be sanctioned, when in fact, the most destructive consequences must inevitably be visited upon every person on board vessels propelled by it, should an accident from any cause whatever happen to a boiler, with which it was charged. And it was furthermore affirmed, that the fracture of boilers containing steam of the pressure ordinarily used in boats, could not subject passengers to injury, inasmuch as such occurrences had frequently taken place, producing no other inconvenience than delay to repair them.

With considerations of this nature the committee could not but be impressed, whether they regarded the responsibility fairly attachable to themselves, in recommending a course for councils to pursue, or anticipated the unhappy and afflicting consequences that might, in the range of probability, occur to those whose reliance for safety should be upon the entire security of the plan proposed.

A new train of reflection being thus excited, the committee were induced again to apply to the gentlemen who had previously aided them with their advice, from whom they solicited the favour of answers to the questions exhibited in the document numbered 2, herewith submitted.

The replies to those inquiries are contained in the communications numbered 3, 4, and 5—now furnished.

Much valuable and important information was derived from those letters, the nature of which has induced the committee to believe, that the use of steam employed in passage boats, is a subject so deeply and extensively interesting to society, as to render municipal enactments inadequate to a complete regulation of those establishments. To the higher authority of the state legislature, they would therefore

earnestly recommend the subject, with a confidence, that its wisdom will devise, and its power enforce, such legal restraints as the object manifestly requires.

With this view, they respectfully submit the propriety of collecting further facts, to accompany a memorial to the Senate and House of Representatives of the commonwealth of Pennsylvania at its ensuing session.

ROBERTS VAUX,
WM. SMITH,
WILLIAM LEHMAN,
HOR. BINNEY,
GEO. VAUX.

Philadelphia, July 14, 1817.

(No. 1.)

(CIRCULAR.)

The unhappy consequences which have resulted from the explosion of the boilers of steam engines, employed in propelling boats for the accommodation of travellers, has excited serious and just apprehensions in the public mind, prejudicial to the interests of those valuable establishments, and requiring the interposition of such as are intrusted with the guardianship of the common welfare. Under impressions of this character, the select and common councils of the city of Philadelphia, appointed a joint committee to inquire what regulations ought to be enforced, in relation to the use of steam, so far as their authority might extend to vessels navigated by that agent, which arrive at, and depart from, the wharves, within the jurisdiction of the corporation. That committee anxious to learn from disinterested persons, of unquestionable scientific knowledge, what mode could be adopted to render the boilers of steam boats perfectly safe, addressed a letter to Professor Cooper, Joseph Cloud, Jacob Perkins, and Frederick Graff, in answer to which those gentlemen have furnished the opinions herewith exhibited. Previously, however, to the adoption of any measures, predicated upon this report, it was conceived to be most respectful to submit it to the proprietors of steam boats. I comply, therefore, with the directions of the committee, in transmitting this circular, with a request that on, or before, the 25th instant, information may be communicated, whether the plan proposed will be acceded to by those interested, or not.

Very respectfully,
ROBERTS VAUX,
Chairman of the Committee of Select and Common Councils

Philadelphia, 6 mo. (June) 12, 1817.

To ROBERTS VAUX, Esq.
Chairman of a Joint Committee of the Select and common Councils of the city of Philadelphia.

The committee to whom was referred the question, "*whether any, and what effectual mode can be adopted, to render the boilers of steam*

engines employed in propelling boats, free from the danger of explosion," having met, and jointly considered the subject, are of opinion,

That, for the purpose of preserving the credit, and securing to the public the benefit of conveyance by means of steam boats, some regulations are absolutely necessary, and may be adopted without injury to the owners of vessels so navigated, whose interest ought to coincide in this respect with the interest of the public.

That two improvements are very desirable: if adopted, would prove sufficient to ensure the safety of the passengers from the dreadful accidents which have lately taken place, by the bursting of boilers, and the explosion of steam strongly heated: these are,

First, to adopt and enforce the following regulations, viz. allowing every captain or owner to navigate his vessel with steam raised to whatever temperature he thinks most expedient for his own purposes, he should be compelled to permit inspectors, appointed by law, once in every month, to prove the strength of his boilers, by loading them for the purpose of ascertaining their strength; first, with double, and afterwards with once and a half the force of the steam he proposes permanently to use, by filling them with water, and loading a pipe with the weight necessary to give to the boiler the required pressure. This can be conveniently managed by pressure on Bramah's principle, and need not occupy an hour's time. Thus, if the captain proposes to work with steam pressing with a force of ten pounds on the square inch, let the boiler be tried with a pressure of twenty pounds on the square inch; and then with a force of fifteen pounds per square inch. If it stands this trial, it may reasonably be presumed to bear the required pressure of ten pounds per square inch, until the next monthly period of trial appointed by law. To make it sure that the engine shall not be worked in any intermediate time, by means of steam affording a higher pressure than that required, let a separate safety valve be provided, and kept locked up in a box connected with the steam engine apparatus, of which box the inspector appointed by law ought to be permitted and required to keep the key, which box should not be opened till the next period of inspection. This safety valve should be regulated to the pressure required, and at which the steam engine is to be actually worked. So that however high the common exposed safety valve may be loaded by those who work the engine, the safety valve, locked up, shall effectually prevent the use of any higher pressure than that permitted.

A *second* improvement would be, to separate the steam engine apparatus by strong partitions erected between this and the part of the vessel occupied by the passengers: which partitions should be so constructed as to be decidedly the strongest part exposed to explosion, should such an event take place. Hence the planking of the sides of the vessel near to the steam engine apparatus, and the part of the deck that covers it, should be purposely made somewhat weaker than the partitions, and more liable to be torn or blown away by an explosion, which in such case could not affect the passengers.

The committee beg leave to observe, that such trials of the strength

of boilers are on the same principle with the acknowledged necessity of trying the strength and resistance of all kinds of fire arms: and that the periodical repetition of these trials is made necessary by the unavoidable wear and tear of the machinery to which a steam engine is exposed.

The second improvement is suggested from the common practice of gunpowder makers, who are also liable to dangerous explosions, and who make those sides of their rooms weak, where an explosion can do the least damage when forced by the strength of the other sides to take that direction.

The committee further observe, that the boilers of the steam engine should be made of sheet and not of cast iron, which in case of explosion is much more dangerous from its fragments than sheet iron. But if the improvements now suggested by the committee should be adopted, it is hardly possible for an explosion to happen at all, or, if it should happen, to prove dangerous in any degree to the passengers in the vessel.

Those owners of steam boats who are willing to submit to the proposed regulations, ought to be strongly recommended to the public in preference to others: but the sense of safety that a passenger will feel in consequence of these improvements being adopted, will be of itself a sufficient recommendation of those boats wherein they are adopted. All which is respectfully submitted.

THOMAS COOPER,
JOSEPH CLOUD,
JACOB PERKINS,
FREDERICK GRAFF.

Philadelphia, June 11, 1817.

(No. 2.)

Thomas Cooper, Joseph Cloud, Jacob Perkins, and Frederick Graff, Esquires.

I am directed by the joint committee of the select and common councils of the city of Philadelphia, appointed on the subject of steam boats, to submit the following questions for your consideration, and request the favour of answers, as early as they can be furnished, consistently with your convenience.

Very respectfully,
ROBERTS VAUX,
Chairman, &c. &c.

Philadelphia, 7 mo. (July) 3, 1817.

First. Whether what is commonly called a high pressure engine is, in your opinion, proper for a passage boat; whether, with the precaution of proving the boiler once a month, and a double safety valve, as proposed by you, will render them perfectly safe; and whether, in case of an explosion when the steam is at the ordinary pressure at which such engines are worked, it would not probably be fatal to the life of most of the persons on board.

Second. Whether an engine that works with a pressure of from seven to ten pounds to the square inch, would, in case of explosion, probably do any injury, except to persons who were immediately adjacent to the boiler, or who were not separated from it by a partition; and whether the common partition in use in boats navigated by low pressure, and the distance at which passengers on deck or in the cabin are from it do not make them safe?

Third. Whether, to your knowledge, boilers on the low pressure plan have not frequently burst without any injury whatever to the passengers; and if any case to the contrary exists, what are the particulars of it? What experience have you on the subject of explosions of high pressure engines, and the consequences?

(No. 3.)

To Roberts Vaux, Esq.

Chairman of a Joint Committee of the Select and Common Councils of the city of Philadelphia.

Sir,—In reply to the further questions proposed by the committee, the undersigned states as his opinion,

1. That whatever be the construction of a steam engine on board a boat, the precautions already recommended in a former report to the committee, are *indispensable* to the perfect safety of the passengers.

2. Although, with due precaution and continual care, the danger arising from engines working with high pressure, may be reduced so as to render them as little liable to explosion as the engines that work with a low pressure, yet accidents must be calculated upon to happen to engines of all and every construction, at one time or other. In such cases, the danger will be far greater from engines worked with steam of high pressure, than with the common engines of Boulton and Watt, or of Fulton. Even in cases where the danger arising from an accident is trifling, the noise, and the vapour that issues from a very small opening in the boiler, or other parts of a high pressure engine, are so much more alarming to persons ignorant of the cause, than when a similar accident happens in an engine of low pressure, that the chance of this happening well deserves to be taken into the account; for the fright and the alarm may have serious consequences, even when there is no real danger.

3. Every engine working with steam beyond ten pounds upon the square inch, ought to be considered as a high pressure engine.

4. Under present circumstances, it seems expedient to give a decided preference to engines in steam boats, where the pressure is below ten pounds on the square inch; for even that pressure is unnecessary, and may, and ought to, be avoided.

5. With respect to the explosions and accidents that have happened on board steam boats, in this country and in England, the statements have been too loose and general, to afford any foundation for an accurate and decided opinion, but enough has been published, to show that these accidents have happened from rashness or negligence,

by means of which, the steam valve has been overloaded, or by using machinery ill made, or too much worn. A steam engine on the construction of Boulton and Watt, may rashly or negligently be loaded with fifty pounds instead of five pounds; but it is manifest, that steam pressed with twenty pounds for instance, cannot possibly do so much damage as steam pressed with two hundred pounds on the square inch. In the latter case it would act nearly with the force of gunpowder, as there is good reason to believe it has often done.

6. As in all civilized countries passengers are under the protection of the law, and ferries and carriers, whether by land or water, are objects of legislative control, this subject seems to the undersigned proper to be submitted to the consideration of the legislature.

THOMAS COOPER.

July 7, 1817.

(No. 4.)

SIR,—In answer to your inquiries, respecting high pressure engines, and those on the Boulton and Watt principle, with steam from seven to ten pounds on board of passage boats, I submit my opinion, without any other motive than that for the safety of the lives of those who travel by that convenient mode.

1st. As respects high pressure engines, I am of opinion, that if the precautions recommended in a former report are rigidly enforced, perhaps explosions would not take place; but presuming that, with all the care of those appointed to make a monthly survey, some part of the work might be overlooked from hurrying the examination, in order to have the boat ready for the succeeding trip; this induces me to believe that it is probable fatal accidents may occur, and many lives be lost, if an explosion should take place.

2nd. An engine that is worked with a pressure of from seven to ten pounds to the square inch, with a boiler reasonably strong, there can be little danger of explosion; but should an explosion take place, I am well persuaded that the danger to passengers in the cabin, or on deck, would be trifling, provided the partitions and deck between the boiler and the cabin are sufficiently strengthened, *and the doors, if admitted at all*, are hung in such way that by the concussion occasioned by the explosion, they would fly shut; I would recommend an additional passage from the cabin to the deck in the after part of each boat, that in case of accidents a more ready passage would be at hand, without being obliged to pass out near the boiler, as is now the case in most of the steam boats on the Delaware.

3d. The only burst which has come to my knowledge in working low pressure steam, happened with one of the boilers at the lower engine of the Philadelphia water works, occasioned by the heads of the bolts burning off over the fire place, and the joints parting; the workmen received no injury, as the fire doors were shut, the boiling water passed into the ash pit.

From all the information I have obtained, it appears, that every accident that has occurred was occasioned by high pressure steam,

applied either in engines adapted for working high steam, or those of Boulton and Watt, which were never intended by the inventors to carry more than six pounds on the extreme. As the Boulton and Watt engines are now worked, with from ten to twenty pounds pressure, I conceive the danger of explosion nearly as great, as with those working at a pressure of one hundred and fifty pounds to the square inch, and in some instances greater, where the construction of the boilers is not adapted to carry more than from seven to ten pounds with safety.

I am not sufficiently acquainted with the injuries that have taken place by the explosions of boilers in working high steam, to give any correct information on that subject.

In order to prove my assertion in favour of working low pressure steam on board passage boats, I submit calculations of the dead pressure acting on each sort of boilers when ready to put an engine in motion.

The dimensions of boilers most approved of for high steam, are cylinders of wrought iron, generally twenty feet long, and two feet six inches in diameter, which, calculated at 150 pounds to the inch, is on the whole superficial surface 3,595,800 pounds, or on each inch in width of the circumference 14,100 pounds, or on the superficial foot 21,600 pounds.

A boiler for a Boulton and Watt engine, built on the same plan, with the same materials, twenty feet long and seven feet diameter, calculated at ten pounds pressure to the inch, is on the superficial surface, 742,020 pounds, or on the circumference 2,630 pounds, or on the superficial foot 1,440 pounds.

From these data, it is obvious that the latter principle must be the safest.

I am, with great respect,
Your obedient humble servant,
FRED. GRAFF.

Philadelphia, July 9, 1817.
ROBERTS VAUX, Esq.
Chairman of the Select Committee of Councils on the subject of Steam Boats.

(No. 5.)

Philadelphia, 8th July, 1817.

SIR,—In reply to the further questions proposed by the committee, the undersigned is of opinion,

1st. That all engines, worked with a pressure above from five to seven pounds the square inch are unsafe, unless the precautions already recommended in a former report to the committee are adopted. That engines which work with a pressure of seven pounds and below, need only a second safety valve, without the proof; for, should an explosion take place, experience shows that the passengers would be perfectly safe. There is no doubt, that in case of an explosion, the higher the steam the greater the danger; but engines may be so

constructed, that there would be no danger, even with a pressure of 150 pounds to the inch. Boilers may be made to withstand the pressure of 600 pounds to the inch, and if proved often enough to detect any defect occasioned by corrosion, or otherwise, it would seem that no explosion could possibly take place.

2nd. If boilers were made so weak as to be *sure* of bursting at a pressure of seven pounds, or below, there would be but little or no danger from such explosions; but boilers have many modifications; some will burst at the low pressure of four pounds, when others will not burst at 300 pounds. The boilers that are constructed to bear the pressure of twenty to fifty, or sixty pounds, the undersigned is of opinion, are the most dangerous, since it is more easy to get the steam up to that height, than to raise it to from 150 to 300 pounds.

3d. As far as the knowledge of the undersigned extends, all explosions that have taken place, where the engines have been worked at seven pounds and below, have done no injury to the passengers. It is the boilers that have been made to bear a higher pressure than seven pounds to the inch, which have proved so fatal; but had the owners known their strength, and been provided with safety valves properly adjusted, no explosions would have taken place, unless they had been constructed like the two on the Mississippi, which have produced such disastrous consequences. This form of boilers should certainly be abandoned; no safety valve, nor any precaution, would make them secure. These boilers are cylindrical, and have flues passing through their centres. The misfortune has not happened by the bursting of the boilers, but has been occasioned by the flue, where the fire is built, being heated to such a degree, when the water has been suffered to get too low, so as to collapse and make an opening for the steam and water to rush out. This was the case with the Washington and Constitution. At the Pittsburg nail factory, where Evans's most improved boilers had been used for a number of years,* it was apprehended that it was time to replace them, and while new boilers were making, one exploded when the steam was at sixty pounds. When examined, it was found that a piece was blown out at the top, about four by six inches. It removed a few bricks, but occasioned no mischief. It was found that the thickness of the iron was reduced by corrosion to less than one sixteenth† of an inch, at the spot where the explosion took place. The undersigned has not been informed particularly, as to the other disastrous explosions, but he believes several have taken place at as low as twelve or fifteen pounds pressure, and that such ought to be considered as high pressure engines.

Yours, respectfully,

JACOB PERKINS.

ROBERTS VAUX, Esq.

Chairman of the Select Committee of Councils on the subject of Steam Boats.

* This rapid corrosion was occasioned by the use of mineral water: since river water has been used no such event has taken place.

† When new it was five sixteenths.

On the Structure and Management of Steam Engine Boilers. By Col. S. H. Long, *U. S. Engineer Corps.*

TO THE COMMITTEE OF THE FRANKLIN INSTITUTE.

Philadelphia, July 9, 1830.

Gentlemen,—At your request, I have the pleasure to submit a few hasty remarks in reference to defects in the construction and management of the boilers of high pressure steam engines, and to the accidents liable to result therefrom, to which I shall take the liberty to add a few observations on the means of preventing their explosion.

The Western Engineer, which was constructed under my immediate direction, and in which the exploring expedition under my command travelled from Pittsburg to the Council Bluffs, in 1818, had three cylindrical boilers, about 15 feet long, and 20 inches in diameter, the iron of which they were made being $\frac{3}{16}$ inch thick. The position of the boilers was horizontal, and their direction parallel to each other, and to the sides of the boat. The fire places were located at the front, and immediately beneath the two exterior boilers. The flues extended backward from the fire places quite to the aft end of the boilers, where they united under the centre boiler, and were returned through a single flue, to the front, and thence ascended through the deck of the boat, passing upward in a chimney about 19 feet high.

The ordinary working pressure of the steam, was 96 pounds to the square inch, as indicated at the safety valve. On some occasions, the pressure was raised to 128 pounds per square inch.

No precautions were taken to cleanse the boilers of the mud taken in from the turbid waters of the Mississippi, till we had ascended about 170 miles in that river; when, in consequence of the difficulty of generating a sufficiency of steam, it was thought best to examine and cleanse the boilers. On removing their caps we discovered that a large quantity of mud had been collected, which was not equally distributed in the boilers, but appeared to have been accumulated in greatest abundance, at those parts of the boilers which had been subjected to the greatest heat, while other parts were comparatively exempt. For example, those parts of the exterior boilers, immediately above the bridge at the backs of the fire places, and especially that portion of the centre boiler immediately above the junction of the two exterior flues, were incrusted with mud to a very considerable thickness. The mud, or rather crust, on the portion last mentioned, was at least two inches thick, and, on further examination, it was found that this portion of the boiler had been enlarged, or *blown out*, (*bladder-like*,) till the apex, or extreme surface, of the enlargement had receded from the original cylindrical surface of the boiler about $1\frac{1}{2}$ inches. An explosion was no doubt prevented in this case by the cracking of the mud crust, and the admission of water through the cracks, the former being occasioned by the enlargement of the interior surface of the boiler at that place, and the latter serving to cool the enlarged side of the boiler before an explosion could take place.

It has frequently been observed, in reference to the steam boilers employed in the western country, and especially to those in which steam is generated by the heat of an intense coal fire, that

those parts of the boiler exposed to the greatest heat, soon became oxidized, and reduced in thickness by exfoliations. This is probably to be accounted for on the supposition that in consequence of the rapid production of steam, a very thin atmosphere of it is formed on the interior surface of the boiler, at such points as are exposed to intense heat, and prevents the water from coming into immediate contact with the boiler.

In the spring of 1820, I embarked at Pittsburg on board of the steam boat Telegraph for St. Louis. The boat was entirely new; had her cabin above the main deck; her boilers in the bow; and her engine and paddle wheels at the stern. The supply or force pump, was, of course, connected with the engine, and the water had to be conveyed to the boilers through a distance of at least 60 feet. The supply pipe was of wrought iron; it ascended from the engine to the upper deck, passed along the upper deck to the aft end of the boilers, descended to, and entered, a horizontal pipe situated midway from the top to the bottom of the boilers, and communicating with them respectively at or near their centres.

Among a variety of accidents that occurred on board of this boat, was the following, which is to be regarded as having a particular reference to the subject before us.

We had not proceeded many days on the voyage, when all on board were alarmed at a sudden and apparently unaccountable cracking and knocking in the supply tube, attended with shocks in that member of the machinery, which produced copious jets throughout its whole extent. This accident was no doubt occasioned by a scarcity of water in the boilers, by reason of which the *debouchures* of the supply tube were left uncovered with the water, and the steam from the boilers gained admission into the supply tube, and on coming in contact with the cold water of the tube instantly condensed.

The surest and safest mode of applying the supply tube to cylindrical boilers, is that effected by means of a horizontal tube, situated transversely of the boilers, a little back of the fire place, and beneath the apron of the aft part of the furnace, from which tube branches lead upward and communicate, through the furnace, with the lower part of each boiler. This tube has sometimes been accidentally stopped, and the passage of the water to one or other of the boilers has been thereby prevented. In order to avoid accidents from a cause like this, especial care should be taken to have the tube large, and free from obstructions of every kind, and especially from nails, &c. which are often used in the construction of *cores* for casting, and are sometimes inadvertently left in the tube.

A piece of timber in contact with, and resting upon, the tops or upper parts of a set of cylindrical boilers, has been known to take fire from heat communicated through the boilers, (probably while the steam engine was in operation,) although the ignited timber was considerably remote from any fire flue. This occurrence was no doubt owing to the transmission of heat through the steam contained in the boiler, resulting from a scarcity of water in the boilers, by reason of which certain portions of them exposed to a strong heat, were not covered with water.

The mode of constructing furnaces for cylindrical boilers, (in the western country,) is such that the heat is communicated to the outsides of the boilers, to the height of about three inches above a horizontal line passing through their centres. Moreover, the longitudinal fire flues usually introduced into the boilers are so situated that their upper sides rise at least to the same elevation, and sometimes higher. Hence, unless the water of the boilers rises to a height somewhat greater than either of those above adverted to, the accident above mentioned, and even others of a more fatal aspect are liable to take place.

These considerations afford a double clue to the prevention of accidents of this nature, viz. 1st. the necessity of a sure test for determining and maintaining the proper quantity of water in the boilers, and, 2nd. of a test by which any difference between the temperature of the water in the boilers and the steam above it, may be detected.

It is true that an increased temperature in the steam above that of the water is serviceable, in preventing the condensation of the former in its passage from the hotter to the cooler parts of the machinery, in which last it must necessarily perform its functions; nor is it deemed impracticable to effect this valuable purpose by suitable apparatus. Yet, in the present structure of the steam engine, safety would be more promoted by maintaining a uniform temperature, both in the water and the steam contained in the boilers.

I shall conclude with a few speculations, suggested in the course of my limited experience and observations, in reference to steam boilers. The remarks I have to offer under this head, are grounded upon certain properties of materials, which I am inclined to think have not been sufficiently consulted in the construction and use of machinery generally, and of steam boilers in particular.

It is a pretty well established fact, that the continuity, tenacity, or strength of materials, is constantly impaired by every force exerted upon them, and by every action they perform, whether continuous or intermitted. For example, a rope or cord continually strained, gradually parts with its tenacity. A spring continually, or occasionally, bent, loses its elasticity. A bell, after having been rung steadily for a long succession of years, will break. The trunnion of a field piece may be broken off by repeated strokes of a hammer or sledge; the number of strokes required for this purpose being in some due proportion to their intensity, and the weight of the hammer. In fine, I have no doubt that all materials, (inasmuch as none are *perfectly* elastic,) are subject to this law.

The inference to be drawn in relation to steam boilers is, that their strength is constantly impaired by the strain exerted upon them, and that, in consequence, they ought to be more frequently tested or proved, in order to determine their ability to resist the pressures to which they are subjected. It is believed that, in most instances, boilers have never been tested beyond their ordinary working capacities; and that whenever they have been proved, a single trial has been deemed sufficient for the entire duration of the boiler.

In order to obviate the danger attendant on experiments of this sort, and to render the trial as economical, easy, and expeditious as

the nature of the case will admit, I would suggest the following method. 1st. Let experiments be carefully instituted and made, for the purpose of determining the tenacity of the different kinds of iron, &c. employed for the construction of boilers, at all the varieties of temperature to which they are subjected in the *raising* and *working off* of the steam. From these experiments let a table be formed showing the diminution of strength for every degree, or 10 degrees of increased temperature, and especially for all temperatures above the oiling point.

2nd. Let a weight be attached to the lever of the safety valve, sufficient to produce a pressure upon the valve, at least one-fourth greater than that imparted by the highest steam ever intended to be used in the boilers; due allowance being made for the reduction of tenacity occasioned by the degree of temperature corresponding to the steam pressure required, which temperature may be determined by a recurrence to Dalton's tables, showing the temperatures corresponding to different densities of steam.

3d. Let the force pump be adjusted in such a manner as to be worked by hand, (by means of a handle or brake adapted to that purpose,) with a view to communicate by manual exertion the pressure requisite to raise the safety valve.

4th. Let the boilers be filled with cold water, the safety valve be closed, and the force pump worked vigorously, till a force is communicated sufficient to raise the safety valve, and the strength of the boiler will have been sufficiently tested. The trial, and proof, may be made as often as occasion may seem to require, and the boilers effectually proved, in half an hour, without serious inconvenience.

Having no leisure to revise and copy, I must crave your indulgent acceptance of the foregoing rough minutes.

I am, very respectfully,

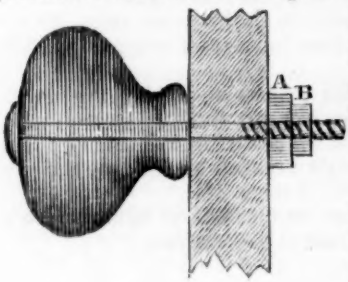
Your most ob't.

S. H. Long.

Secure Fastening for Drawer Knobs.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Sir,—I have been often plagued in my furniture by the glass knobs, now so much used, becoming loose; and I find that no successful expedient has hitherto been adopted to remedy this annoyance. After several fruitless efforts, I have at last hit upon a plan, which I have found to be completely effectual, and at the same time, it is very simple. The annexed cut being a section of the knob and spindle, will represent the contrivance.



A, is the ordinary nut. B, an extra nut, which I form octangular, or hexagonal, to make a better finish. Putting on the knob and spindle, as usual, I

screw up the nut A, until the knob has the degree of tightness at which I wish it to remain. Placing then a key, made of a plate of brass or iron, on A, to keep it from turning, I screw B strongly against it; and I find that on turning round the knob and spindle they carry with them both the nuts, if properly put on. The reverse of this, in ordinary cases, is the cause of the knobs becoming loose.

The use of two nuts clamping each other, is familiar to all persons conversant with machinery; all the merit I claim, is that of applying this well known contrivance to the remedying a domestic annoyance, which, from its frequent occurrence, may be termed a serious evil. W. H.

Baltimore, September 15th, 1831.

FRANKLIN INSTITUTE.

Monthly Meeting.

The stated monthly meeting of the Franklin Institute, was held at their Hall, on Thursday evening, August 25th, 1831.

Thomas Fletcher, Vice President, in the chair.

The minutes of the last meeting were read and approved.

The following donations were presented to the Institute.

By Messrs. Carey and Lea.

The Family Dyer and Scourer, being a Complete Treatise on the art of Dying and Scouring.

By Mr. Reuben S. Gilbert.

The Cabinet of Natural History and American Rural Sports, No. 8, for August.

By Mr. W. C. Redfield.

Remarks on the prevailing Storms of the Atlantic Coast of the North American States, by the donor.

A letter from Hardman Phillips, Esq., of Phillipsburg, Pa., was read, accompanying the following specimens, viz:—

Coke made by the process of distillation.

Coke made in the open air; and

Iron in the various stages of its manufacture, from the ore to the completion of screws.

Mr. Phillips says, "my principal object in submitting these specimens to public inspection is, to invite the manufacturers of Philadelphia, to the study of the resources of their own state, (so well calculated, if duly fostered, to render the country independent of foreign supplies.")

He also states, "that after the process of making the blooms, which is done at the forge, the principal part of the subsequent manufacture is performed by boys from the charitable institutions of Philadelphia. Neither is there a single mechanic at this time about the works who has not learnt his trade at them."

The corresponding secretary laid on the table the following works received in exchange for the Journal of the Institute.

Recueil Industriel, for March.

Bibliothéque Physico-economique, for May.
Annales de Chimie et de Physique, for February.
Bulletin de la Societé d'Encouragement pour l'Industrie Nationale, for January and February.
The Ladies' Book, for August.
Southern Agriculturist, for August.
The Illinois Monthly Magazine, for July.

Mr. Keating stated that the Horticultural Society of this city had issued a circular asking for information relative to the cultivation, consumption, &c. of dyer's madder, barilla, and woad, which has been republished in the Journal of the Institute—whereupon, this subject was selected for discussion at the next meeting of the Institute.

THOMAS FLETCHER, *Vice President.*
J. HENRY BULKLEY, *Rec. Sec.*

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JUNE, 1831.

With Remarks and Exemplifications, by the Editor.

1. For an improvement in the *Mill for grinding Grain;* John Ambler, Jr., and Daniel C. Ambler, New Berlin, Chenango county, New York, June 13.

The Messrs. Ambler obtained a patent on the 6th of Dec. last, for an improved portable grist mill, the runner of which was to be kept down by means of heavy weights; the present patent is taken for some further improvements which have been suggested by experience. The mode of hanging, balancing, and driving the stone has undergone some alteration; but the principal point appears to be the substituting of a spring for the weighing formerly employed to keep the running stone down. To a beam above the stone "is attached a spring so placed that it acts on the steel point, and holds it firmly in contact with the safety rod,—which prevents the upper stone, or runner, from rising when the feed is fast. In case any large articles pass between the stones, this spring yields, and allows the stone to raise sufficiently to let the article pass between them." "The eye of the runner is to be made larger near its face than it is above."

"The parts to which we lay claim as original are the manner in which the upper stone is prevented from rising when grinding fast, by means of a spring, and the arrangement of the parts as specified; also the making the eye of the runner larger near its face than it is above; and the manner in which the upper stone is balanced and driven."

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2. For improved modes of *drawing off two separate liquids, which, by their union, produce an effervescing beverage;* John Ambler, Jr., New Berlin, Chenango county, New York, June 13.

This patent is taken for an apparatus similar in its object to that described at p. 176, patented to Justice Perkins, May 3.

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3. For a *Carriage to run on Rail-ways;* William Bryant, and Isaac Keit, Davidson county, Tennessee, June 13.

This carriage is intended to run upon a single rail, in a manner resembling that of Palmer's, patented in England. The carriage is suspended so as to hang below the rail upon which the wheel runs. From the frame by which gudgeons of the main wheel are sustained, an arm projects, upon which there are wheels, or friction rollers, which acting upon the top, and on each side of the rail, serves to guide the carriage, and renders it unnecessary to use flanches.

The whole apparatus is described and figured without any part being designated as new, although it is manifest that the principle has no claim to novelty. The particular arrangement of the parts described, differs sufficiently from that adopted by Palmer to have admitted of a specific claim.

Notwithstanding the apparent simplicity of the *single rail*, its employment involves a complexity in the adaptation of the carriage, and in other particulars which appear to be objectionable. We believe that Palmer's rail and carriage have been used for the purpose of experiment only; at all events, we have never heard of any thing further respecting them, although they were patented three or four years ago. To sustain a rail at the height required by this plan, with that degree of stability which is necessary, offers such practical difficulties as are very likely to prevent its adoption.

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4. For a machine for *Shelling Corn and Cleaning Grain;* Ezra Bond, Mendon, Monroe county, New York, June 13.

The patentee tells us that "the said machine consists of a cylinder and curve, with iron spikes in each. Also wire screens, and wooden wings for winnowing grain; and a revolving apron to conduct the grain into the machine. The said curve springs agreeable to the quantity of corn or grain between the spikes of the curve and cylinder, all of which move by turning of a crank; and for a more full description, a drawing is herewith annexed, to which reference may be had, and which forms part of this specification."

It will be seen that a number of old acquaintances are congregated together in the foregoing description, and upon examining the different features they all appeared perfectly familiar. We, however, shall imitate the patentee, and not make any claim to them, as they make no part of our own offspring.

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5. For an improvement on the *Mechanical Fan*, patented on the 27th November, 1830; Jas. Barron, Esq., Navy Yard, Philadelphia, June 13.

In the former specification, the fan was made to vibrate, like a pendulum, by means of a weight acting upon wheel work. The improve-

ment now claimed is the "giving motion to the fans, &c., by means of two pulleys, and a connecting band, producing a rotary, instead of the crank vibratory, motion, formerly used."

A suitable frame is made to sustain moveable pulleys, and a weight which is wound up like the weight of a jack. Arms project from the top of the frame, and from these descends a rod, at the bottom of which there is a "cross bar, or stick, on which are placed the fans and shreds, or threads, for creating a breeze, and driving away the flies and moschettos."

This plan is much more simple than that originally patented, and noticed in vol. 7. p. 170. For a machine to keep off flies, we have employed an apparatus intended for another purpose, which is no larger than a quart mug, and one that may be frequently found for sale at our stores; we allude to the spring roasting jack, which is wound up like a clock, and will run for an hour or more. The fanning, or fly driving apparatus occupies the place of the meat, and instead of roasting the dead animal, the living one is cooled, and protected from the flies.

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6. For a *Complete Churner;* Cyrus Baker, Charlton, Saratoga county, New York, June 13.

This is the common dasher churn, but it is to be worked by machinery. A frame is made, across the upper part of which there is a shaft with a crank at its centre; a pitman, or shackle bar, descends from this shaft to the dasher of the churn. A large cog wheel is to be turned by a hand crank, and this takes into a pinion on the crank shaft, which works the dasher up and down.

Four pages of description introduce us to a knowledge of the structure of the foregoing machine, which, after all, has about as much claim to novelty as it has to simplicity.

The claims are to the use of the cog wheel, to the way in which the holes are slanted for the play of the handle, &c.

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7. For an improvement in the *Machinery for Spinning Cotton, &c.;* John Brown, Stonington, New London county, Connecticut, June 13.

Those who are acquainted with Thorp's ring groove spinner, and with the various modifications of that invention, which have been described in this journal, will perceive that the improvement claimed by Mr. Brown consists of another variation in the mode of applying the same principle.

"The ring is made of steel or iron, turned true, having a groove on each side near the inner edge. In this ring is a sliding piece let in about half way the thickness of the ring, to admit the travellers for guiding the thread. The travellers are small pieces of hardened steel, bent in a circular form,—open at one side. They move in the grooves in the rings, and guide the threads."

The claim is to the "making the ring in two parts, so as to admit the travellers;—hardening the travellers; making also a double ring

with a groove between them to admit the traveller to run in it. Likewise the mode of giving the machine an accelerated motion."

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8. For a machine called a *Self-balanced Hand Cart;* George Coolidge, Watertown, Middlesex county, Massachusetts, June 13.

This is a kind of hand cart, or barrow, for removing earth in excavating for canals, and other purposes. The body is made with the sides sloping, and is suspended upon two wheels, 4 feet 6 inches in diameter, by means of gudgeons, or axles, which are attached to the body near its upper edge. There are shafts, or handles, which are formed by the elongation of the top timbers of the frame of the cart, and a leg extending down from each shaft, like the legs of a wheel barrow. The bottom of the cart is made to fall, being made in two parts, which are hinged to the front and back of the frame, like two shutters. From these shutters, rise chains, which hitch on to a pin on the side of the cart, when the shutters are closed. A lever, which passes out alongside one of the shafts, acts upon the chains, and lowers or raises the bottom.

The use of the legs is to support the weight of the shafts, and the action of the lever; as, were these removed, the body would still remain suspended, the principal part of it, and its whole load, being below the point of suspension. The whole of the body lies within the circumference of the wheels, its length not being equal to their diameter. The earth is, in general, to be dropped by letting down the bottom, but when it is moist and adhesive, the body is to be inverted by raising the shafts, and turning them completely over.

The wheels are, of course, to run upon planks laid down for the purpose. Each cart is to contain 11 or 12 cubic feet of earth, and a number of them may be linked together, and drawn by horses.

There is no claim made, and perhaps the general plan is sufficiently novel and distinctive without particularizing the parts. There is, however, one effort at exactness which, were specifications to be construed rigorously, would endanger many a patent; namely, the precise dimensions of all the parts. We are told, for example, that "the wheels are 4½ feet high; spokes 1¾ wide, and 1¼ thick; felloes 2½ inches wide, 1½ inches deep; tire 2½ inches wide, and ¼ inch thick." And so of all the other parts.

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9. For a machine for *Chopping Meat, Pulverizing Spices, Hommony, &c.;* Benton P. Coston, city of Philadelphia, June 13.

A round wooden block is to have its upper end excavated in the form of an inverted cone; a cylinder of tin, or other metal, is to extend up from this excavation to form the sides of the mortar. A chopping knife, with two edges, adapted to the cone, is to be fixed on to one end of a handle, or shaft, and at its other end there is fixed an iron pestle. The shaft is to slide in guides, keeping the knife or pestle in the centre of the cone, and one end, or the other, is to be turned downwards, according to the kind of work to be performed.

There is no claim made, the whole, wooden mortar and all, being, of course, considered as a new *invention.*

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10. For *Propelling Machinery, and driving the Stones in Grist and Flour Mills;* Jeremiah Case, Sodus, Wayne county, New York, June 13.

This is for a reacting wheel, and we are told that "the improvement is in the application of the reacting wheel to the shaft to which the stones are attached, without gearing; by which greater velocity is gained with equal power, than by any other method now in operation, rendering the use of gearing unnecessary." "The reacting wheel, which is three feet diameter, is placed on the lower end of the shaft, in a horizontal position, and at the foot of the shaft is inserted a concave iron box, resting on a pivot of hemlock knot, or other hard wood, placed upright in the bridge tree." These are the main points of the description, after which the patentee adds, "I further claim as my invention, an improvement on the reacting wheel, in the construction of the buckets which allow an equal space through them for the discharge of the water; avoiding the inconvenience to which these wheels have hitherto been subject by being made wedging, and thereby retarding the motion. I also claim as my improvement, the use of the wooden pivot, and the mode of applying it to the concave iron box, as mentioned in my description."

The drawing is a very poor affair, but there is a sketch of the wheel intended to be used, which appears to be that invented by Calvin Wing, and described in the specification of a patent obtained by him, inserted p. 87 of our last volume.

ENGLISH PATENTS.

To THOMAS COBB, *Esq. for his invention of certain improvements in the manufacture of paper, intended to be applied to the covering of walls or the hanging of rooms, and in the apparatus for effecting the same. Sealed 15th September,* 1829.

THE invention for which this patent is granted, is a mode of producing an embossed surface of papers intended for covering walls of rooms, by which a beautiful effect can be produced on papers which are coloured in the pulp, and not stained after the paper is made, as is usual with paper hangings; and by which also, silks, velvets, or other coloured goods can be put upon the surface of paper, and when embossed will produce a rich and beautiful appearance.

SPECIFICATION.

"My improvements in the manufacture of paper, intended to be applied to the covering of walls or hanging of rooms, and in the apparatus for effecting the same, consist, first, in manufacturing tinted or coloured paper intended to be applied to the covering walls or

hanging rooms, by impressing them with patterns during the operation of making; secondly, embossing paper with patterns for the same purpose, after the paper is made, and which, by the pressure it receives during this operation, is made to resemble plain damask or figured silks; thirdly, in uniting two or more thicknesses of paper together for the same purpose, previously to their receiving the embossing, one of which may be coloured paper, and the other white; fourthly, in uniting for the same purpose, paper with silks, velvets, and other fabrics, so that, if plain, they may receive an impression or pattern by embossing, and may also be struck on walls with the same facility as paper only is commonly done; and, fifthly, in the apparatus for uniting the paper or papers, and other fabrics, as above mentioned. First, in some cases, I make a coloured or tinted paper, and in doing this, I dye or stain the rag or pulp by any of the known methods of dying or staining them, and make it into paper in the usual way; and during the process of manufacture, and before it is dry, I cause it to pass between rollers, and receive an impression therefrom, one or both of which rollers are engraved, stamped, or impressed, or covered with something that will give the pattern or figure required, by which operation it is impressed, and receives a pattern or figure; or the same thing or effect may be obtained by using plates or other flat substances, in or on which the required pattern or figure is formed, by laying them on the paper in its way to the pressing rollers, so that in passing through them, it receives the figure or impression.

"Secondly, in other instances, and particularly where I want a shining article to resemble silk, I make my paper as before described, by any of the known methods, and when dry, I pass it through rollers, one or both of which are engraved with the pattern required, and at least one of them heated, so that the impression obtained may be stronger and more shining; and it is not necessary the paper for this purpose should be always coloured or tinted in the rag or pulp during the process of manufacture, but either coloured paper so made, or paper which has been made white, and afterwards coloured by any of the known methods, will do equally well for this purpose; neither is it necessary the paper should be made in long lengths, although I prefer it so, and it may either be made so by machinery, or a number of sheets may be joined together, or sheets may be impressed by either the heated rollers or plates passed through heated rollers, and united in putting them on the walls so as to form the pattern intended, when combined. In some cases, I give part of the impression during the operation of making the paper, by which it is twilled or lined, ribbed or striped, by passing it through rollers prepared according to the purpose intended, which causes it to appear thicker than if pressed flat and smooth, and prepares it to receive a stronger impression; and I afterwards, when nearly or quite dry, pass it through other rollers, one or both of which are heated, and on which are other patterns, so that part may be shining and other parts not so; and whenever it is particularly desirable that the paper should retain its shining quality in a greater degree, I size it strongly with

animal or vegetable substances, and sometimes use gums or wax therein.

"Thirdly, I contrive to unite two or more thicknesses of paper together, either during the process of making, or afterwards, by introducing between them any of the glutinous substances, or articles, calculated for the purpose, and one of these papers may be of any colour required for the outside, and the other may be coloured or white for the back, and may also be of a coarser and stronger description than that which is intended for the outside: and when these papers are so united, they are passed through the pattern and heated rollers, or pressed with the plates as before described, to give the pattern required: and in general I prefer these double or compound papers to those which are of one sheet or thickness only, as they take the impression and preserve the patterns better, and are less injured by the operation of pasting, in putting them upon the walls.

"Fourthly, instead of the double paper before described, I take plain or figured silks, satins, velvets, cottons, linens, or other fabrics for the one side, and unite these with paper by introducing any of the glutinous substances, or articles calculated for the purpose, between them, in the way before described when two or more thicknesses of paper are used; and when so united, if the article is plain and wanted to be figured, I emboss it with any pattern required, in the manner before described, and by ribbing or twilling it, by passing it through rollers prepared to give it this appearance after it is united with the paper, I give an inferior silk the appearance of a much more valuable one, and allow of the paper thus united being pasted and stuck on walls in the same manner, and with as great facility as though it were paper only.

"In either of the cases before mentioned, I produce the embossing effect by means of a swing press, where the figure or pattern occurs but seldom, to the screw of which press a plate with the intended pattern is attached, having a chamber above it to receive a heater, for the purpose of making the impression stronger and more lasting. With this and the other modes of embossing, I sometimes use leaf gold, or other metallic substances, so that the whole, or part, of the impression may be covered thereby, (as in the binding of books,) and in some cases I take paper which is already covered with gold, silver, or other metallic substances, and emboss and cut out the figure intended, so as to fit the impression made in embossing. In other cases, and particularly when plain silks are united with paper, I produce a pattern, or effect, called watering, by pressing two thicknesses or pieces together between heated rollers, or in a press face to face, so that during the operation of pressing, one may bruise the other, and produce the effect described.

"The patterns intended to be employed for the above purpose, admit of all the varieties of engraving and impressing, which can be used for embossing, in the manner before described, and they may be made to appear as though they were woven in the material, or embroidered or embossed thereon, according to the article which it is intended to resemble, the intention being to make paper appear

like silks, cloths, &c., of greater value than itself, and to have a similar effect in improving the appearance of silks, or whatever articles are united or combined with the paper; and the novelty of my invention consists in giving the improved appearance in the manner herein described, to papers intended to be applied to the purposes of covering walls or hanging rooms, as above stated; I do not claim any thing new in the process of making paper, farther than what is described under the first head, viz. the method in which the figure or impression is given during the manufacture of the paper for this particular purpose; and though embossing has been used for various other purposes, yet I claim it as new when applied to papers prepared in the manner described, or when united with other fabrics for the purpose of covering walls or hanging of rooms, as above said."

[*Lond. Jour.*

To WILLIAM DETTMER, *Piano Forte Maker, for his invention of certain improvements on piano fortes. Sealed 30th August*, 1827.

THE object of the patentee in adapting this invention to piano fortes, is to enable the instrument, after having been properly tuned, to be brought into unison with other instruments of a different pitch, by raising or lowering the tone of all its strings by a simple operation, instead of the trouble of tuning each string separately.

The plan applies both to grand piano fortes and square piano fortes, and whether horizontal or upright, and consists in adapting to the ordinary construction of instruments, a series of tension bars or rods, with adjustments which are to extend across the instrument, and to be connected to the block in which the pins that hold the strings are fixed, the blocks being moveable for a short distance, not more than a quarter of an inch, but confined by the tension bars.

The general construction of the piano forte, as to the keys and movements, and the arrangement of the strings, the blocks for the hitch pins and for the rest pins, being the same as in other piano fortes, the novelty consists in attaching the ends of a series of metal bars, or rods, to the hitch pin blocks, and connecting the reverse ends of the same bars to the rest pin block; these bars being enabled to elongate or contract by means of adjusting screws.

Supposing each of the strings of the instrument to have been drawn up by the turning key to the required note, that is, properly tuned, but that when so tuned the whole should be found to be too flat or too sharp to play in concord with other instruments in a concert; by simply moving the adjusting screws of the tension bars, the blocks to which the strings are attached will be brought nearer together to flatten the tone, or farther apart to sharpen it, as may be required, without deranging the tone or notes of the individual strings.

The patentee says that both the blocks on which the strings are hitched, and that in which the rest pins are set, may be made to slide, but he prefers that the rest pin block only should move, and this may be done by passing the adjusting screws through the block into the

tension bar, when, by turning the screws, the block will be moved a short distance, and the tension of all the strings will thereby be increased or relaxed.

The same effect may be produced by means of wedges or levers, or some other contrivances, in place of the screws, but that which has been described is preferred. [*Ib.*

To JOSEPH HORTON, *boiler maker, for his invention of a new and improved method of forming and making of hollow cylinders, guns, ordnance, retorts, and various other hollow and useful articles in wrought iron, in steel, or composed of both those metals. Sealed* 11*th October*, 1827.

THESE hollow cylinders are proposed to be made by combining a series of bars of iron or steel, placed lengthwise round a cylindrical mould, and after bracing them together by means of iron hoops, and raising the temperature of the whole in a furnace to a welding heat, the mass is to be beaten with hammers upon a mandril, until all the pieces are united in a solid compact state.

It is proposed that the several bars shall be made in a small degree wedge-shaped in their sectional figure, in order that they may lay close together, when combined in a cylindrical form, like the stones round the arch of a bridge.

Several modes of effecting this object are proposed beside the wedge form, as, for instance, a series of square bars may be laid, with triangular bars intervening, or some other mode may be adopted for bringing the sides of the bars nearly into contact, before they are submitted to the heat of the furnace; and when so heated, to a welding state, the joints may be closed by tilt hammers, or by sledge hammers, as may be most convenient, according to the magnitude of the cylinder about to be made.

The plan is proposed for making cylinders of iron or steel for any purpose, but particularly for ordnance, which may be formed by these means, observing that the bars for that purpose, must be thicker at one end than at the other, in order to afford such additional substance, as may be required towards the breech part of the piece.

When the gun has been thus formed upon a mandril, and all the joints of the combined bars rendered perfectly sound by the operation of welding, it may be bored within, and turned without to its proper figure, and will be a much better and stronger gun than any heretofore made by the ordinary process of casting. [*Ib.*

Patent granted to S. SMITH, *Builder, for certain improvements in chimneys for dwelling houses, December* 14*th*, 1830.

THIS patentee proposes to constitute chimneys, or rather flues, of iron tubes to be cast of appropriate lengths and diameters, according

to the intended capacity of the flue. These are to be built into the wall, and constitute a circular opening lined with iron. Each piece of pipe is cast with one end somewhat enlarged, to receive the smaller end of the succeeding piece, and when the chimney flues are to be turned from the straight course, kneed or bent pieces of pipe are introduced to give any required curvature.

In addition to the introduction of cast iron tubes, to constitute chimney flues, Mr. Smith claims the invention of a method regulating the size of the flue at the foot of the chimney, by the application of a pair of hollow iron cones, attached at their bases, which must be made equal to the flue in diameter. A cross piece is attached to the apex of the upper cone, whose ends move in slots made for their reception in the lower piece of tubing. From each of the cross bars two chains pass over two pulleys fixed in the chimney, a small distance above the cones, where the two chains are connected, and passed down through an aperture coinciding with the axis of the cones, where it is furnished with a counterpoise. And by this the cones may be elevated so as to close the chimney entirely, and to answer the purpose of a chimney board, when fires are not wanted; or they may be lowered to regulate the opening to any assignable size, according to the required draft, depending upon the quantity and kind of fuel employed.

There is nothing new in the first part of this patent, for a plan of making flues of iron pipes was proposed several years ago.

Mr. Smith's method of adjusting the size of the flue to the draft required appears to be new, and likely in many cases to prove useful.

[*Regis. of Arts.*

Patent granted to MICHAEL DONOVAN, *of Dublin, for an improved method of lighting places with Gas. April* 16, 1831.

IT is a well known fact that hydrogen gas, obtained from the decomposition of water by its being passed through red hot iron, or masses of ignited charcoal, will readily burn if lighted when it comes in contact with the oxygen of the atmosphere as it issues from a pipe; and that its illuminating powers under such circumstances, are so small as to render pure hydrogen inapplicable to the purposes of gas lighting. To augment the illuminating properties of hydrogen, generated under such circumstances, by the admixture of some other gaseous material, is the object of Mr. Donovan's invention. He proposes to convert spirits of turpentine, or similar substance, into vapour by the heat of the gas burner itself in the following manner:—

The hydrogen gas in its passage to the burner passes through a metallic cavity immediately connected with the burner, and in this cavity is introduced a quantity of wire gauze to give extended metallic surface. Into the interior of this cavity is introduced a constant supply of turpentine, which being spread over the metallic surface of the wire gauze, becomes, by the heat of the burner, converted into vapour in the cavity where it mixes with the hydrogen;

giving to it a sufficient quantity of carbon to produce the illuminating powers required. If too much of the vapour of turpentine be mixed with the gas, the issue of an inconvenient quantity of smoke from the burner will take place; and when too small a proportion of this vapour is introduced, a deficiency of light will be the consequence: and, therefore, great care must be taken to proportionate the size of the burner, the supply of hydrogen, the size of the metallic cavity and surface, and the supply of turpentine, to produce the greatest quantity of light with the least smoke. [*Ib.*

Patent granted to BENJAMIN ROTCH, *Barrister at Law, for improved Guards, or Protectors for horses' legs and feet, under certain circumstances. March* 18, 1831.

THE improved guards here contemplated are to be made of caoutchouc. When it is to be applied to a horse's foot the neck is to be cut from a caoutchouc bottle, it is then to be softened by immersion in hot water, and drawn over a block made in the form and size of the foot for which it is intended. On this block it is permitted to cool, when it will retain its shape, and by its elasticity it will adhere to the horse's foot when drawn on it. On the exterior of this shoe is to be applied a sole of sheet iron, made of sufficient size to allow of its edges being cut and turned up round the hoof, to keep it on the foot, but it is also fastened to the Indian rubber by means of very broad and thin round headed rivets; and to the iron sole may be fastened, if required, horse shoes of the usual form.

A method of making and applying the guards for the legs of horses is next described in the specification. For this purpose both the top and bottom of the caoutchouc bottle are to be cut off, the middle piece is then to be soaked in hot water to soften it, and cooled on an appropriate block, as before. One or more of the elastic bands thus prepared are to be applied to such of the legs, or to the knees, of the animal, as require protection; and they will be preserved in their places by the elastic nature of the substance. When they have been laying by in cold weather, they are apt to get hard, and in that case it is recommended that they should be warmed before they are applied. When they are to be used as bandages it may be sometimes necessary to cut them and fasten them with straps and buckles, and in that case the straps must be attached to the caoutchouc at some distance from the edge, otherwise they will be apt to be torn off.

The drawings attached to the specification represent a horse's fore and hind leg, with the guards applied to the feet and fetlock, and to the knee, as well as at the top and bottom of a cloth with a poultice applied to the leg.

With respect to the time, (*twelve months,*) which this patentee has obtained for preparing his specification, we think it deserves notice as a curious illustration of the *laws' delay;* for nobody but a lawyer would have thought of requiring, and very few would have had the means of obtaining, a whole year to mature and describe that which

almost any person at all acquainted with the subject would have readily accomplished in half an hour: for here are neither delicate experimental investigation, requiring time to mature and repetition to confirm, nor intricate mechanical construction, requiring the confidential aid of others to bring to perfection.

We consider that the different periods allowed by the present practice to different patentees for the enrolment of their specifications, is one of the principal defects of the system: and Mr. Rotch, from the experience that he has had in that branch, and to which he recently said to a committee of the House of Commons, that he had directed particular attention, cannot but be aware, that if A, for instance, takes out a patent for an improvement in the steam engine, and takes twelve months to enrol the same, and B subsequently takes out a patent, also for improvements in the steam engine, and obtains but two, four, or six months to enrol his specification, there is nothing to prevent A from inspecting B's specification in the enrolment office, and adopting it as his own; as he was not required to give any description of his invention at the time he obtained the patent.

It is not a little singular, that Benjamin Rotch, Esq. of Bath, on the 11th of May, 1816, took out a patent for "a flexible elastic horse shoe," consisting of "two or more pieces of iron, steel or any other metal, attached either by the nails which fasten the shoe to the foot, or by rivets expressly for the purpose, or sometimes by both, or otherwise fastened or applied to one or more pieces of leather, hat, *Indian rubber*, or any other flexible substance." The application to this circumstance of the following extract from the evidence of Benjamin Rotch, before a committee of the House of Commons, on the patent law, will readily occur to the reader:—

"Look, (says he,) at the danger of allowing patents for improvements, even with the consent of the party, on articles that are already patented; it would continue a patent *ad infinitum:* improvement on improvement, just as their fourteen years are expired: because it is what patentees come to me constantly to know, if they cannot, for some little improvement, obtain a patent on their own patent, which would be an extension of the term to twenty-eight years instead of fourteen, and thereby shut the public out of the benefit they are to have at the end of fourteen years."

Now it would be very interesting to know whether Benjamin Rotch, of Bath, in 1816, be any relation, or at all connected with Benjamin Rotch, of London, in 1830.

Patent granted to WILLIAM CHURCH, *for certain improvements in the construction of Boats and other vessels. March* 9, 1831.

MR. CHURCH proposes to employ sheet iron in the construction of boats and other vessels, as well as for rail-way carriages. The iron plates are to be united by riveting, in a manner similar to that adopted in the construction of steam boilers; and the joints must be all made air and water tight. The exterior of the boat thus

formed, is furnished with a lining similarly constructed. A space of a few inches is left between the exterior casing and the lining; and in this space is introduced a series of iron plates bent into the form represented in the cut, to give strength to the vessel. These

strengthening plates are secured to the casting and lining by rivets or bolts, and the space between the linings is enclosed at the top, air tight; and by that means much buoyancy is obtained from it in cases of danger when the boat fills with water. The deck of the vessel is also to be made of plate iron, which is to be secured and strengthened in a manner precisely similar.

To prevent the mast from being injured by the edges of the iron plates, a piece of iron tube, of dimensions to correspond with the diameter of the lower end of the mast, is introduced through, and firmly secured to, the deck.

The top rail of the bulwarks is made of iron tubing connected together by passing their ends into sockets, and connected with the sides of the vessel by iron plates bent in the form of the surface of a pantile roof, to give them strength.

A description of the Economical Oven, or apparatus for procuring alcohol from dough in the process of baking bread.

Under the head of *New Process of Distillation*, at page 417 of our last volume, we gave some account of the invention for which a patent was granted to Mr. Robert Hicks of London, by which the alcoholic vapour arising from fermented dough in the process of baking, was condensed and collected. We have now procured a drawing of the apparatus employed, which will serve to render the mode of procedure perfectly intelligible. This drawing, with the accompanying description, we have copied from the Register of Arts, for February last.

It will be readily conceived that the numerous small fissures in an ordinary oven of *brickwork*, arising from imperfect fittings and other causes, render the material unfit for the preservation of the vapours given off: Mr. Hicks accordingly employs an oven made of *iron* in lieu of brick; but the bottom of the oven on the interior side is lined with a pavement of bricks, on which the loaves are placed as usual; a fire is made underneath the oven, at a proper distance, and brick flues from thence are so arranged that the heated air shall envelope every part of the exterior of the oven, to diffuse the heat in the interior of it as uniformly as is practicable. The door of the oven is made to fit the frame accurately, by grinding their surfaces, or by luting when set to work, and these parts are brought into firm contact by a cross bar and screw in the usual manner of fastening the mouths of retorts.

In the drawing accompanying the specification, two modifications of the apparatus are exhibited. The first is an oblong oven five feet

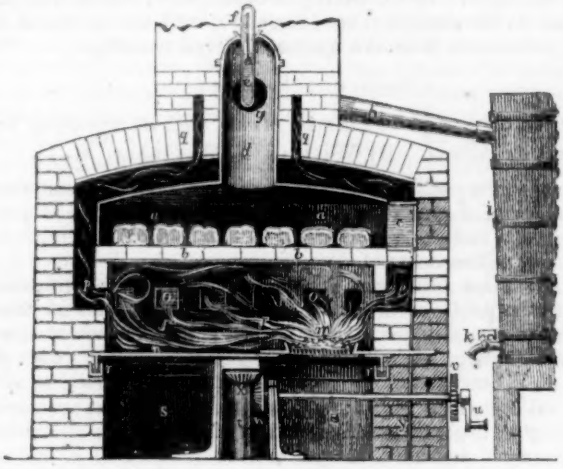
wide and seven feet long, and the fire place, or grated receptacle for the fuel, is placed underneath the middle of the bottom, and is framed so as to be drawn, parallel with the length of the oven, backward or forward, or to be drawn entirely out of the apparatus when required. By the usual position of the fire, however well regulated may be its intensity, there is a liability of the central part of the bottom of the oven to become overheated; partly owing to the bottom being lined, internally, with so bad a conductor of heat as bricks. To protect the oven from this injurious effect, a large plate of iron, about half the area of the oven, and twice that of the fire, is suspended by a hooked iron bar centrally to the bottom of it; and being posited about midway between the fuel and the bottom of the oven, prevents the flame and heated gases from acting directly upon the bottom of the oven. The door of the ash pit is provided with an air regulator, and the minor flues around the oven, (made by numerous holes in the brickwork,) unite in the upper part, where a horizontal flue leads into a common chimney.

In the centre of the top of the oven a large iron tube or neck, about twelve inches in diameter and thirty inches long, is fixed vertically, extending through the brickwork which covers the oven. In this tube the vapours from the bread are collected, and are conducted from thence, by a lateral tube, into a common distiller's worm, which being surrounded by cold water the vapours become condensed, and are drawn off into a proper receiver for the liquid. This liquid, consisting of a mixture of water, alcohol, and other matters, which being afterwards rectified, will furnish a fine spirit of wine.

In order to regulate the temperature of the oven, an iron tube about the size of a musket barrel, closed solid at the lower end, and about a foot long, is suspended vertically in the middle of the neck, by passing through a tapered hole in the top of the latter, whereon the tube rests by its upper end, which is spread out into a conical or bell-mouthed form for that purpose. In this tube oil is deposited, and into the oil is placed the bulb of a thermometer, whose graduated scale above, extending outside of the apparatus, exhibits the temperature of the oil, and, consequently, also that of the oven.

The other modification of the machine described in the specification varies from the preceding in the arrangement of the furnace part. In the first, the fire-grate was *stationary* during the baking; in the second, which we have now to describe, it is made to *revolve*. For this purpose the oven is made circular, and at a suitable distance from the bottom of it, (about a foot,) is a large circular plate of the same diameter as the oven, (six feet,) which turns in a horizontal plane, on a vertical axis, forming a complete partition between the fire place and the ash pit; except in a portion of the circle where the *fire grate* is situated, which is nearly of a sectoral form, to afford a more uniform distribution of the heat, and a greater facility of pushing the grate into, or drawing it out of, its place, under the oven. In order that the air which is admitted into the ash pit to promote the combustion may not be diverted from its proper course, that of passing through the grate on which the fuel is deposited, the patentee

makes the whole circumference of the revolving plate air tight by what is termed an hydraulic joint. Near to the periphery of the circular plate, is fixed a descending rim of three or four inches deep, which dips into a circular trough, filled with water, that rests upon the brickwork surrounding the ash pit; and the revolving plate being wholly supported upon its central axis, the part of the apparatus is rendered as complete in its action as it is simple in form. The motion is communicated to the grate by bevel gear of the usual kind.



The preceding cut affords a sectional view of the last mentioned modification of this baking and distilling machine. *a a* is the iron oven; *b b* the brick floor made level with the bottom of the doorway *c; d* the chamber where the vapours from the bread are collected; *e* the oil tube suspended by its bell-mouthed end in a hole at the spherical extremity of the water chamber; *f* the thermometer with its bulb immersed in the oil contained in the tube; *g* a large aperture through which the vapour escapes into the crane neck, *h*, leading into the refrigerating worm tub, *i*, wherein the vapour becoming condensed is drawn off by the cock, *k*, into a proper recipient. *l l* is the fire place, of which *m* is the grate, resting between ledges on the large circular revolving plate *n n; o o o* are lateral apertures or flues in the brickwork, leading to the general surrounding flue, *p p*, which terminates in the flue, *q q*, leading to a common chimney, not represented in the drawing. *r r r* shows the circular water trough into which the descending rim of the revolving plate dips throughout its circumference. *s s* is the ash pit; *t* the vertical axis of the revolving plate, to which motion is communicated, either by a boy turning the handle *u*, (or any convenient power applied to the pulley *v*,) which actuates the bevel gear w and x. At y is the register to regulate the admission of air to the fire.

When the thermometer indicates a temperature of 280° Fahren-

heit, the oven is at a proper heat for the baking of bread, during which process, the heat should be maintained at from 280° to 310°, and the vapour drawn off through the refrigerator, for subsequent rectification to obtain the vinous spirit. After the bread has been baked, and the pastry, (as customary,) is introduced into the oven, the action of the condensing apparatus is dispensed with; which is effected by turning the cock at the worm tub, and the oil tube and thermometer being withdrawn, the vapour escapes at the aperture thereby left open. In the baking of biscuit also, which, like pastry, undergoes no fermentation, and, therefore, contains no alcohol ready formed, the vapour is in like manner suffered to escape.

Remarks on the use of Surcharged Steam, with an account of experiments thereon.—By William T. Haycraft, M. D.

The Repertory of Patent Inventions for July last, contains the specification of a patent for improvements in the steam engine, by Dr. Haycraft; and the same number furnishes the following remarks explanatory of the views of the patentee.

The invention described in the accompanying specification, is offered to the public in the full confidence that it is a real improvement on the steam engine, and well worthy the attention of scientific and practical men. I have for many years pursued a series of inquiries on the mechanical properties of steam, especially of what is usually called surcharged steam, i. e. of steam that has been subjected to a higher temperature than that at which it was generated, in which process the steam is increased in volume, with a proportionate increase in mechanical power; the process itself being effected at a comparatively small expense of fuel. In pursuing these inquiries, I have found from the effects of surcharged steam in several experimental engines, that when the cylinder is properly constructed, the power produced is far greater than that from ordinary steam. Encouraged by this success, a 12 horse power engine has been erected, which in its working, has proved the truth of my principles in a most satisfactory manner.

It will, however, be proper, before giving a more full account of this engine, to endeavour to correct some errors which practical and even scientific men have fallen into, concerning steam when applied to produce power, which I shall endeavour to do in the most familiar language the subject admits of.

It is generally supposed, that if steam be heated above the temperature at which it is generated, its force is not increased; that it is even diminished; that the super temperature, by some means or other, kills or destroys its elasticity. I will first endeavour to show how this mistake has arisen.

The following experiment was made by Mr. Perkins, assisted by Mr. Penn, Jr. at his steam engine manufactory at Greenwich, and similar experiments have been made by others.

Surcharged steam was made by passing small quantities of water

through a system of cast iron tubes, heated to a high temperature. This surcharged steam was applied to Mr. Penn's engine of, I believe, 6 horse power; after a short time the engine lost its power, namely, as soon as the cylinder had acquired a super-temperature, although there was abundance of steam.

What could be the cause of this? Most practical men would say that the surcharged steam had lost its elasticity, and, therefore, its power to work the engine. Messrs. Penn and Perkins, however, discovered the fault and endeavoured to remove it. The fault was that as soon as the cylinder became considerably heated, the packings of the piston and piston rod could no longer confine the steam, and it appeared on examination, that these packings had become completely dried, and therefore easily permeable by steam—that, consequently, its force could not be exerted on the piston. To remedy this, the surcharged steam was first passed over the surface of water contained in a second boiler, by which process it rapidly absorbed water till it was saturated, when the engine worked perfectly well. The reader will, however, perceive that in this case, the surcharged steam, by imbibing an additional dose of water, was converted into ordinary steam, which is disposed, when introduced into a working cylinder, to deposit a portion of its water; because the cylinder is of a lower temperature than the boiler. This water, by moistening the packings, renders them, to a certain degree at least, steam tight. The same fact has been observed in condensing engines, when, from the boiler being by accident almost empty, and the fire being urged, so that the upper part of the boiler was extremely heated, and the steam thereby was surcharged. In this case, although there is abundance of steam of the usual pressure, the engine will not do its work.

We had an excellent opportunity of observing this *apparent* want of power in surcharged steam, in an experimental condensing engine. In this engine the steam was surcharged by means of high pressure steam surrounding the cylinder. The piston was provided with metallic plates, which acted well: the piston rod had the usual hemp packing. The engine worked well for some time, until the piston rod had become considerably heated, and its packing dried, when all at once a rushing of air was heard through the packing, and quantities of air were pumped up by the air pump, and the engine lost its power. The power could be restored by moistening the packing, or by pouring in quantities of oil, which latter however passed through with the greatest rapidity.

From the foregoing observations it will appear, that the *apparent* want of power in surcharged steam, is to be attributed to the great difficulty of keeping the joints and packings tight, arising from the disposition which surcharged steam has of drying and injuring the packings.

The experiments from which we some years ago directly proved the *increased* power of surcharged steam, are very simple. They consisted in accurately weighing a copper ball containing steam of the boiling temperature, then by immersing the ball in heated oil, till it attained the temperature of 312°, allowing the surplus steam to

escape by a small orifice, which was subsequently closed very accurately; then by subtracting the weight of the empty ball from the two weights, it appeared that steam surcharged to 100° above the boiling point, weighs $\frac{1}{10}$ of ordinary steam, it being still able to bear the atmospherical pressure; thus one volume is converted into ten volumes, each of which, if its temperature be preserved, will produce a mechanical power equal to the original volume; that is, we increase the whole power ten-fold.

Then the question became, how can we confine this surcharged steam so as to make it available to produce power? We have already seen, that it is from its disposition to dry the packings, that surcharged steam so freely escapes in waste. After a number of experiments with different fluids, my brother and myself found that water, when interposed between the surcharged steam and the piston, was capable of effecting our object. It is well known that water passes through compact organized porous bodies with great difficulty. This is shown in the hydraulic press, in which water under a pressure of several thousand pounds on the square inch, is kept tight by a simple collar of leather. To be assured of the practicability of this to the steam engine, a model was constructed which was so arranged that water could be introduced between the piston and the working steam, or not, at pleasure. When the water was not interposed, there was a waste of steam through the packing at a pressure of 30 lbs.; but when water was interposed, the engine worked perfectly tight at a pressure of above 600 lbs. on the square inch.

Thus we arrived at two important facts; first, that steam is capable, by receiving a super-temperature, of increasing its power in a ratio equal to its increase of volume; and, secondly, that by the intervention of water between the steam and the packing, we are able to make a perfect joint completely impermeable by steam. It would be evident, however, that if water were interposed directly between the surcharged steam and an ordinary piston, it would be soon dried away, and our intentions would be defeated. For the purpose of obviating this, the arrangements as described in the specification, have been made, and the truth of the principles laid down completely put to the test. In an experimental engine, the effect of the surcharged steam is very extraordinary. When surcharged steam is used, the engine does not require one-tenth part of the steam, and what is singular is, that the power of the engine is improved thereby. In this engine, the boiler is not sufficiently large to supply steam of 30 lbs. on the inch, but the moment the steam is surcharged, the steam pressure rises in the boiler till it arrives at 200 lbs., the engine going with its full power the whole of the time, after which the escape by the safety valve is evidently greater than the quantity consumed by the engine. The surcharged steam, after escaping from the engine, is perfectly invisible, so that no appearance of steam can be observed at any time. This shows the extreme rarity of surcharged steam. In the 12 horse power engine that has been erected, we have not attempted to surcharge the steam to so high a degree, for reasons that shall be given, yet its action is equally satisfactory.

There is another point very important to practical engineers, which seems to have escaped the notice of writers on the subject, and was equally unknown to the celebrated Watt, namely, the production of cold *within* the cylinder, occasioned by the evaporation of water deposited on its internal surface. This evaporation takes place every time the vacuum is formed, it of course occasions a production of cold, which in its turn causes a fresh deposition of water, and waste of steam. Although Mr. Watt does not appear to be aware of these series of actions taking place, yet he was perfectly sensible of the great utility of preserving the temperature of the cylinder. For this purpose he used to surround it with steam from the boiler, thinking it to be sufficient to prevent condensation, that the cylinder should be kept at the same temperature as the steam. Had he been aware of the cooling process we have described, he would probably have perceived, that to prevent the evil, it would be necessary to surround the cylinder with steam of a *higher* temperature than that of the working steam; in which case no condensation would take place with the consequent evaporation, cooling of the cylinder, &c. In doing this, however, a practical difficulty presents itself; for if this be attempted in ordinary engines, the water is no longer deposited, and, as we have before shown, the packings become dry, and no longer steam tight. The intelligent reader, on examining the principles of the surcharged steam engine, will perceive, that this drying of the packings cannot take place, although the surcharged end of the cylinder should be raised to ever so high a temperature, the presence of water on the other side of the piston will always effectually preserve them from drying or other injury.

We have sufficient proof of the correctness of these principles in the action of Woolfe's engine. It has been supposed that the saving of fuel in this engine, arises from the use of two cylinders, one of high pressure and the other a condensing cylinder; the escape of the former working the latter, in which arrangement the steam acts by expansion, as it is termed. That the saving is not entirely occasioned by this cause, was shown by an accident which happened in an engine of this description at Mr. Newcomb's mills at Stroud Water. The reader is aware that the condensing cylinder in this engine is surrounded by high pressure steam; now it happened that the high pressure steam jacket was injured, so that the engineer blocked up the pipe leading into it; in this state, the cylinder was no longer surrounded by high pressure steam, of course the working steam was no longer surcharged; the consequence was, that the engine could no longer do its work. The jacket, &c. being repaired, the engine then went perfectly well. In this engine hemp packings are useless, for the reasons given, instead of which metallic pistons are used, which, when the steam is only slightly surcharged, and of a moderate pressure, answers sufficiently well.

There is also a great advantage in using steam of a higher pressure than can be used in engines of the ordinary construction. My brother, Mr. Samuel Haycraft, has found in using high pressure steam, that in increasing the pressure, the quantity of steam expend-

ed is not increased in the same proportion; that, in fact, the quantity of steam expended, is only as the *square root* of the pressure; that is if we increase the pressure four-fold, the quantity of steam required will be only twice as much, by which in proportion to the power produced, there is a saving of one-half: If we increase the pressure nine-fold, the quantity of steam is increased three-fold, by which there is a saving of two-thirds of the steam, and so on in the same proportion. But this cannot be effected to any great extent in ordinary engines, because the packings are not sufficiently tight at high pressures. But we have shown, that by means of the arrangements proposed in our improvements, our packings are able to sustain a pressure of more than 600 lbs. on the square inch, without leakage. It is by a combination of the principles of working high pressure and surcharged steam, that the greatest advantage is to be derived: thus, we found in the experimental engine, working at 200 lbs. pressure on the square inch, with surcharged steam, the expenditure of steam was only one-tenth of the quantity used, when unsurcharged steam of 30 lbs. on the inch was used: thus the power compared to the quantity of steam, was increased more than sixty-fold, the engine working perfectly tight.

The 12 horse power engine referred to, has been constructed agreeably to the plan laid down. The boiler is of a size usually adapted for a 4 horse power engine, and it works the engine at its full speed, and at a full power of twelve horses, calculating 220 lbs. pressure on the piston for each horse, exclusive of friction. The boiler evidently makes more steam than is necessary, the steam constantly escaping by the safety valve, when the engine is going at its full power, although the fire is kept low, and the boiler is only set in a temporary manner, with a very short chimney. The engine also works under the disadvantage of being completely exposed to the open air. The boiler is of the strongest form, being a cylinder twenty-six inches in diameter, and ten feet long. It is made of the best forged iron; and has been proved to above 500 lbs. on the square inch. This engine is computed to consume one-half a bushel of coals per hour, being about one-half of the quantity required in a Woolfe's engine of the same power.

In this engine we have not attempted to carry the surcharging and high pressure to its greatest extent, as without so doing, the effect sufficiently answers our expectations, and the saving of fuel is so great as to make any further saving, at least in a fixed engine, of comparatively small consequence.

But the superiority of this engine is not confined to its saving in coals, for it is evident that its saving in water is still greater. When we consider that in all engines, and especially in high pressure ones, a great quantity of water is thrown up from the boiler into the cylinder with the steam, which has been estimated by practical men to be full one-half of the whole quantity used, we shall perceive that as by the surcharging plan the whole of the water is converted into steam, the saving of water will be twice as great as the saving in steam. Now the saving in steam is, on the lowest calculation, *com-*

pared with ordinary high pressure engines, three-fourths of the whole quantity, the surcharged steam engine requiring only one-fourth of the coals, will require only one-eighth of the water. In applying this to the subject of locomotive engines, we will consider it in the following way:—First, the load required for supplying the engine, consists of one part of coals to six parts of water, because one pound of coals will boil off six pounds of water. Therefore, if we suppose the load necessary to supply the engine, to be two tons, the weight

of the coals would be - - - Cwt.	5	2	24
The weight of the water, - - -	34	1	4
Cwt.	40	0	0
By the use of the surcharged steam engine, the quantity of coals will be - - - -	1	1	20
The weight of water - - - -	4	1	4
	5	2	24
So that there would be a saving of the load required, equal to - - - - Cwt.	34	1	4

The great advantage of lessening the load in a locomotive engine, especially if intended for the road, is self evident; it will in effect be increasing the power of the engine, and of course the velocity of the carriage. Also, by thus lightening the load necessary for the engine, we shall be able to carry such an increased supply, that we shall be enabled to travel three or four times the distance without fresh loading. We shall also be able to increase the *steam power* to a great extent.

It must be familiar to the reader, that the two obstacles to the complete success of locomotive engines on the common road are, the want of steam power adequate to the load required, and the too frequent necessity for stopping to take in a fresh supply of water and coals. These two obstacles the surcharged steam engine will completely remove.

The surcharged steam engine may also be made more compact in its form than any other, arising chiefly from the smallness of the boiler, or generator, required.

It should also be observed, that this estimation of the saving of fuel and water, is on the least favourable scale. I have shown, that by combining a considerable steam pressure, (200 lbs. on the inch,) with completely surcharging the steam, the power produced was increased sixty-fold, compared to that produced by an equal quantity of steam not surcharged. This almost incredible effect was produced by the application of a moderate fire directly to the surcharged part of the cylinder. This engine has been frequently worked in this manner for several hours during many months, yet, although the cylinder is of brass, it was never in the least injured by the fire; also the piston packing and the other joints were always perfectly tight. Even should it be apprehended, that in the course of time, the cylinder might be injured, that part of it which is exposed to the fire may be

replaced in a few hours, by a new spare piece, without in the least disturbing the working part of the cylinder, piston, &c. On this plan, the saving of steam may be carried on to an almost unlimited extent.

The only objection of moment which has been made by the many practical men who have seen the engine is, that owing to the large size of the piston rod, which, in fact, may be considered as a second piston, there is an increase of friction. This is certainly true, but at the same time, the advantages arising from the arrangement are so great, and the power is so much increased, that it must be considered in the same light as Watt's addition of the air pump to the condensing engine, which although from its friction, &c. it requires some power to work it, yet at the same time, it adds so much more power to the engine, that, on the whole, it is a real improvement. From the small size, however, of the cylinder in this engine, it is evident that its friction must be less than that of a condensing engine.

Many also object to the use of high pressure engines, from a mistaken idea of the danger attending them. Perhaps, on the whole, however, they are even safer, owing to the greater precaution used in having a boiler or generator of the greatest possible strength. In the engine we have erected, the boiler has been proved to above 500 lbs. on the square inch, so that it would require an error of more than 400 lbs. on the square inch to render it unsafe, which error can hardly happen: on the other hand, few low pressure boilers would be safe at a pressure of 25 lbs. on the inch, so that an error of 20 lbs., should the safety valve be obstructed, would be dangerous. In the surcharging engine especially, the boiler is so small, that its safety is secured. The reader is aware that Woolfe's engine, as improved by Mr. Hall, works with a high pressure boiler, yet its working gives general satisfaction. The surcharged steam engine may indeed be considered nearly the same in one of its principles with Woolfe's, namely, the working with surcharged steam, excepting that in the latter, the steam is only very slightly surcharged. In our engine, the steam is completely surcharged, and the full advantage of the principle is thereby obtained. Woolfe's engine also, being on the condensing plan, cannot of course be used for locomotive purposes, and from its being somewhat complicated, perhaps is not quite so well adapted for navigation; although for mills, &c. it is the best engine hitherto known. The surcharging engine, from its compactness, its great saving in coals and water, and its increased power, is peculiarly adapted for these purposes, and I have but little doubt but that its use will eventually become general.

To express in a few words the principal feature of the surcharged steam engine, we would say, that it accomplishes the important desideratum of having a perfectly steam tight piston packing. It should be recollected, that it was the opinion of the celebrated Watt, that the chief cause of the waste of steam in the steam engine, is the want of tightness in the piston; and it is known that he laboured many years in endeavouring to effect this object. Since that time, it has

been attempted by many of the most skilful engineers without success.

The other feature is, that by means of a prolonged piston or plunger, there is a complete separation between the surcharged end of the cylinder and its working part, by which means, the steam can be worked in a completely surcharged or rarefied state, and the piston, being also covered with water, is effectually preserved from injury.

Remarks on the construction and peculiarities of the four Engines employed at the competition for the prize given by the Liverpool and Manchester Rail-way. From Wood's Treatise on Rail-roads. New edition, 1831.

TABLE.

Names of Engines.	Area of fire grate in feet.	Area of *radient* surface in feet.	Area of *communicative* surface in feet.	Cubic feet of water evaporated per hour	Lbs. of coke required to evaporate a cubic foot of water.
Rocket . .	6.	20.	117.8	18.24	11.7
Sans Pareil	10.	15.7	74.6	24.	28.8
Novelty .	1.8	9.5	33.		
Old Engines	7.	11.5	29.75	15.92	18.34

In examining the above, we find a very important effect in the economy of fuel, produced by the Rocket over the old engines, in the proportion of 11.7 to 18.34, supposing the heating powers of coke and coal to be equal. The cause of this is very obvious, and is entirely attributable to the use of the tubes of small diameter, presenting such an area of surface to the water in the boiler. These tubes were used at the suggestion of Mr. Booth, treasurer to the Liverpool and Manchester Rail-way Company, and nothing, since the introduction of those engines, has given such an impulse to their improvement.

With a less area of fire grate than the old engines, the surface exposed to the radiant heat of the fire is as 20 : 11.5, and the surface exposed to the communicative power of the heated air and flame, as 117.8 : 29.75, nearly four times as great.

Nor is this the only difference; in the old engines, the *area* of the tube, (of 22 inches diameter,) for the passage of the flame and heated air to the chimney, was 380.13 inches; and of this large body of flame and air passing through the tube, only an extent of surface of 69.11 inches, was exposed to the water in the boiler. In the Rocket engine, the area of heated air and flame in 25 tubes, 3 inches each in diameter, was 176.7 inches, while the surface exposed was 235.6 inches.

It is not necessary, perhaps, to pursue the comparison further.

The economy of fuel which must result from the exposure of so much greater surface to the water, cannot fail to ensure a more perfect abstraction of the heat, and thus not only save the fuel, but prevent great part of the previous destruction of the chimney, by the intense heat of the *wasted* caloric.

The same remarks apply to the Sans Pareil of Mr. Hackworth, as to the old engine, though in a less degree. In the Rocket, the surface exposed to the radiant heat of the fire, compared with the area of fire grate, is as $3\frac{1}{3}:1$, while in the Sans Pareil it is only $1\frac{1}{2}:1$; the same proportion as in the old engines. In the Rocket, the surface exposed to the heated air and flame, compared with the area of fire grating, is as $19\frac{2}{3}:1$; while in the Sans Pareil, the proportion is only $7\frac{1}{2}:1$. The bulk of air passing through the tube of the latter, will, at its exit into the chimney, be 176.7 square inches, the exposed surface being 47.12, or, 25 : 1, nearly; while, as before stated, the bulk of air passing through the tubes of the Rocket, is 176.7 inches, or precisely that of the Sans Pareil, while the surface exposed, is 235.6 inches, or $1\frac{1}{3}:1$. These will sufficiently account for the great difference in the economy of fuel between the two engines; the Rocket requiring only 11.7 lbs. to convert a cubic foot of water into steam, while the Sans Pareil required 28.8 lbs.

Some explanation is, perhaps, necessary, why the Sans Pareil should, in this respect, be more extravagant than the old engines, while the extent of surface, compared with the area of fire grate, is much greater, and therefore should exhibit a more economical result: and this explanation is the more necessary, as, though not appearing at first sight, it involves a principle of the greatest importance in the economy of those engines; and which, if not acted upon, would render the use of the tubes, however otherwise valuable, considerably less effective.

It will readily occur to any one, paying a little attention to the matter, that the system of tubes may be carried so far, as to reduce the temperature of the flame and heated air, nearly equal to that of the water in the boiler; in which case, when it reaches the chimney, it will be incapable, from its reduced temperature, of producing a sufficient draught of air through the fire grate. This would prevent all the advantages being taken of the refracting powers, which would otherwise result from the use of these tubes. It is stated, in another part of this work, that on the introduction of those engines, it was necessary to resort to the application of the waste steam thrown upwards into the chimney, to create a sufficient current of air through the fire; which was afterwards laid aside, or only partially used, when only slow rates of speed were required.

Mr. Hackworth had, it appears, in his engine, resorted to the use of this in a more forcible manner than before used, throwing it up as a jet, and which, when the engine moved at a rapid rate, and the steam thereby almost constantly issuing from the pipe, had a most powerful effect.

This, though effecting the object for which it was intended, being carried too far, partly in consequence of the rapid speed at which

the engine was made to travel, was productive of another evil, which, though operating fatally so far as regarded that particular experiment, was capable of easy remedy.

The consequence was, that when the engine began to travel at the rate of 12 or 15 miles an hour, the draught was so great, that it actually threw the cinders out of the chimney with considerable force, producing a destruction of fuel enormously great, so much so, that the consumption was at least 692 lbs. per hour.

The area of fire grate of the Sans Pareil, was 10 feet; supposing that the area of the fire grate of the Rocket had been the same, the consumption of the latter engine, with its power of exhaustion, would only have been 361 lbs.; showing that the force of draught was so much greater in the Sans Pareil, as to consume nearly twice the quantity of fuel in the same time.

This will satisfactorily account for the apparent anomaly in the consumption of fuel with this engine, compared with that of the old engines, having a single tube; otherwise, though not likely to have come up to the Rocket in point of economy of fuel, we should have expected an effect considerably greater than in the old engines. The combustion of the fuel being so very rapid, and the abstracting surface so small, the heated air would pass off at a very high temperature; thus accounting for the loss of effect.

The knowledge of this fact,—or rather, availing ourselves of this power for the purpose of creating a draught in the chimney,—leads us to an inquiry of great interest. By an extension in the use of these tubes of small diameter, there is little doubt of our being able, (supposing we can force the necessary quantity of air through them,) to reduce the temperature of the heated air, before its exit into the chimney, nearly equal to that of the water in the boiler. This would be abstracting all the useful heat, and probably effecting all the economy of which the fuel is susceptible.

Perhaps it would not be adviseable to carry it quite so far as this; for when the temperatures become nearly equal, the abstraction of heat would be so slow, as to require a greater length of tube than it would be convenient to employ. We may, therefore, suppose, that in all cases, the temperature of heated air passing into the chimney, will be greater than that of the water in the boiler. The heat will, however, be insufficient, in engines of this kind, to cause a sufficient quantity of air to pass through the fire for the purpose of combustion; and it becomes a question, whether we should allow a portion of the heat to escape for that purpose, or, by contracting the exit of the escape of the steam from the cylinders into the chimney, to effect the same object.

Whether the last method is the most economical or not, though there is every reason to suppose it is, perhaps it is the only one with these engines that is suitable for their action upon rail-ways, especially for quick travelling. The performance of those engines depends entirely upon the quantity of steam they can raise in a given time; and when travelling at the rate of fifteen miles an hour, or upwards, the production of steam is required to be very rapid indeed:

the mode of producing a proper draught through the fire, by throwing the steam into the chimney, after its passage through the cylinders, is, perhaps, therefore, the best; as the quicker the engines travel, and when, consequently, the necessity for steam is the greatest, the then rapid and almost continuous exit of the steam into the chimney, increasing in proportion to the increased speed of the engine, produces, at the same time, a correspondingly greater quantity of steam.

In the "Rocket" engine, this mode of increasing the draught of the chimney, was but partially used; the steam was made to pass into the chimney, by two pipes, one from each cylinder, and the size of the aperture was not, therefore, sufficiently small to cause the steam to pass into the chimney with adequate force; still, in that engine, we find it only required 11.7 lbs. to evaporate a cubic foot of water,—36 per cent. less than with the old engines. We shall afterwards find, that this has been considerably more reduced in the engines lately made.

The "Novelty" engine is on a different principle from those previously considered, the necessary supply of air to the fire, being produced by a bellows. In this case, a chimney becomes unnecessary, and from the way in which the Novelty is constructed, the air was forced through the fire in a very condensed or compressed state. The area of fire grate being little more than one-third of that of the Rocket, and the surface exposed to the radiant action of the fire, less than one-half the temperature to which the fire was raised, must, of course, be considerably greater, to evaporate an equal quantity of water in the same time. The abstraction of heat would be probably more perfect in the Novelty, for the tube through which the flame and heated air passed in its exit to the atmosphere, was 36 feet in length, in one tube; whereas, in the Rocket, there was the same length, though subdivided into six tubes. It is, however, extremely questionable, whether one tube 36 feet long, or 6 tubes, each 6 feet long, *of the same sectional area*, are most preferable: the latter would, of course, give a much greater exposure of surface. The area of exit of the heated air, into the atmosphere, of the Rocket, was 25 times that of the Novelty; from which we may imagine the degree of compression necessary to force the same quantity of air through the fire; though we do not say, that to raise an equal quantity of steam, an equal quantity of air, in that highly compressed state, is necessary.

It was much to be regretted that the experiment with the Novelty could not be continued sufficiently long to ascertain the power of raising steam, by this method; the inquiry was of the utmost importance. Theoretically considered, we are of opinion, that this mode of generating steam, is more economical in point of fuel, than in engines, the combustion of the fire of which is kept up by the rarefication in the chimney; but there are practical objections to set against this, of which, the destruction of fire bars, and the power required to work the bellows, are not the least. We say theoretical, because, suppose two generators, the area of the grate bars, extent of radiant and communicative surface, are in both the same, except the area of

exit pipe into the chimney, which with the generator worked by the bellows, is *one-half of that* by exhaustion of the chimney. If the same quantity of air pass through the grate bars in each, that with the bellows, will necessarily be of a more compressed state, to force the same quantity of heated air through the narrow exit; and this compressed state of the heated air will, of course, cause more of the caloric to be abstracted, than in the other case; for we suppose the temperature reduced to the same, in both cases, in the exit pipe. For if the heated air, in both cases, pass into a chimney of the same area, and equal to that of the exit pipe from the generator, on the exhaustion principle, the temperature of the heated air being supposed to be the same, in both cases, in the exit pipe, the heated air from the generator with the bellows will, therefore, have to expand itself in the chimney into twice its volume, which will, of course, reduce its temperature below that of the other; thus proving a more complete abstraction of the heat. The only question is, whether the disadvantage in practice, consequent upon the operation of such a principle, does not counterbalance any advantage gained in the economy of fuel; and this we must leave to experience to determine.

The question between the two modes, however, assumes a new character, since the application of the steam from the cylinder to create a current of air in the chimney; as in that case we can, by the use of a greater number of smaller tubes, reduce the temperature so low, until, if adviseable to do so, it is equal to that of the water in the boiler. And it then becomes a subject of inquiry, which of the two modes occasions a greater loss of power in obtaining the necessary current of air; the working of the bellows, in the one case, or the loss of power by the obstructed passage of the steam into the chimney, in the other.

It is, perhaps, necessary, after the above disquisition, to explain, so far as we are able, the cause of the failure of the Novelty engine at the Liverpool experiments, to show that it arose from no defect in the principle, but only in the construction of that engine. It will be seen by the sketches of this engine, that the flame and heated air, after leaving the fire, passed through the winding pipe of the horizontal generator. The generator was only 12 inches diameter, and there were three folds of the flue tube within it, in diameter from 4 inches at one end, to 3 inches at the other; very little space was, therefore, left between the flue tube and the top of the generator. The temperature of the flame, within this tube, when the engine was running at a quick rate, would be very great, especially where it left the upright generator; and the evolution of heat would therefore be so rapid, that the passage of steam out, would prevent the water from flowing along this horizontal generator; and the consequence was, that the flue tube got dry, and either collapsed with the heat and pressure, or gave way at the joint. This, it will be seen, however, arises from no defect of principle, and was easily remedied.

[*Rep. Pat. Inv.*

On the Law of Patents, as it exists in England.

We copy the following article from the London Journal of Arts and Sciences; as it contains many remarks applicable to the patent law of our own country, although particularly directed to that of England. From many of the defects of the English statute, and the practice under it, we are fortunately exempt; it is, however, universally acknowledged that the laws of the United States upon this subject are susceptible of great improvement.

We have been favoured with a copy of a small pamphlet, written by Mr. Richard Roberts, of Manchester, on the subject of our existing Patent Laws, with his views as to the best mode of amending them. This little work contains many valuable and judicious remarks upon this important subject; and as the pamphlet has only been privately circulated within the circle of the author's immediate friends, we have taken the liberty of making a few extracts, which we have no doubt will be acceptable to our readers.

It is acknowledged that mechanical inventions and improvements are beneficial to the public, and as men cannot be compelled to give their inventions or improvements to the public gratuitously, it is expedient to induce them to do so, by the hope of a due reward.

This reward is given in the least objectionable shape by granting to the inventor or improver, a patent of monopoly for a limited period; at so moderate a rate of charge as may put it in the power of such parties as are the most likely to invent or improve, to avail themselves of the monopoly.

A high rate of charge for a patent amounts in effect to a prohibition from taking one out, as it regards a large portion of those who are most likely to make discoveries: high charges, therefore, so far defeat the objects for which patents are granted, as they tend to check invention, and to cause to be withheld from the public, that which it is desirable the public should be possessed of.

No evil can arise from an increase in the number of patents taken out; because, if the discovery be worthless, the public is not injured; and if it be valuable, the greater the number of valuable discoveries made known, the more is the public benefitted.

Patentees, in general, are not likely to be over rewarded. Some few may be eminently successful; but, from the delay and expense of experiments, and from a disinclination in society to depart from established practices, a large proportion of them will either gain but little, or will even sustain loss. But, whether the patentee be rewarded or not, the public will be benefitted, if the invention patented be a valuable one.

Patents ought to be cheap; because the granting of a patent is merely recognising in an inventor, his property in his own invention for a limited period, on condition that he shall afterwards give the invention to the public; for, without his consent, no other person can avail himself of it.

Any sum charged for a patent, beyond its actual cost to the nation,

has the effect of a tax on inventions; which must be paid, whether the thing taxed be saleable or not.

Whilst patents are expensive, the men most likely to make discoveries, (managers, foremen, and working mechanics,) are unable to obtain them: consequently, their inventions will, in but comparatively few instances, be made public; and, even in those instances, it will be by the inventors sacrificing to others a large portion of their own interest, in order to secure the remainder.

The expense of making experiments, and of specifying inventions, is so great, as frequently to leave a man, after such expenditure, but little wherewith to obtain a patent: and if he begin by taking out an expensive patent, he may thereby be deprived of the means of making the requisite experiments and of specifying. In the former case, when his experiments precede the taking out of the patent, being through its high price incapacitated from securing a legal protection for his property, he is obliged to abandon the invention: whereas, under the same circumstances, a cheap patent might have put it into his power to benefit both himself and the public. In the latter case, when the taking out the patent precedes the experiments, the title of the patent gives to the public some knowledge of the invention; but, not being sufficiently matured, from want of means, it is rendered valueless both to the inventor and to the public. A dread of either of these results deters many persons from applying for patents.

Men of property who have had experience in the results of machinery, will not often be induced to risk their money in expensive patents; knowing, as they do, that before any profit can be realized, beyond the cost of experiments and of the patent, many years generally elapse; during which time there is considerable risk of the invention being superseded.

Many valuable machines are invented, which from various causes cannot be brought into profitable use for a great number of years. Few inventors of such machines can afford to pay a high price for patents.

A cautious man will generally take a considerable time, perhaps years, to decide whether or not he will risk the large sum now required for a patent; during which time the public loses the benefit of the invention.

Many things of a comparatively trifling nature are invented, which, were a cheap patent obtainable, would get into extensive use, and thereby benefit the public; but, when the inventor will not risk the large sum now required, the benefit of the invention is lost to the public, as well as to himself.

The early introduction of a useful invention or improvement is always of consequence to society, and therefore ought to be encouraged by the granting of cheap patents.

Patents, if cheap, would be taken out for many inventions, individually of little value; by which the patentee might possibly sustain loss, but the public would be benefitted. Besides, many of such inventions would either suggest a new idea, or by calling the attention of mechanics to what was looked upon as desirable, be the indirect

cause of a further beneficial invention or improvement. This is proved to be the case in countries where patents are cheap, as an examination of the list of patents, especially in France, will testify.

By an increase in the number of patents obtained, greater publicity would be given to the most approved machines, or modes of operation, previously in use; for, as the greater number of inventions are for improvements in old machines, or modes of operating,—and it is requisite to describe much of the old machine, or mode, in order to explain the new invention,—the public would thus become acquainted with many mechanical combinations and processes of art, which probably were previously but little known.

By the encouragement which cheap patents would afford, many valuable inventions and discoveries would be published, through the patent office, which otherwise would either die with the inventor, or make their way to the public very slowly. The following inventions may be considered to be under this predicament.

The discovery of a principle, any practical application of which does not immediately present itself to the discoverer; or the means of making which application may not be then at his command.

The discovery of a mode of producing an original screw, of greater accuracy than can be produced by any known mode.

The discovery of a mode of dividing straight lines or circles, in a more simple and accurate manner than any hitherto known.

Discoveries of this nature, notwithstanding their importance to society, could seldom be profitable to a patentee; but still, if a patent were cheap, the discoverer would obtain one for the mere chance of remuneration; and at the same time to gratify his laudable ambition to be recorded as the inventor: and in this way, by the publication of the invention, society would be benefitted.

If a machine is intricate, and one machine, or one establishment with a given number of such machines, would be capable of supplying the demand of an extensive district; the inventor, rather than incur the risk involved in the obtaining of an expensive patent, with the view of remunerating himself by the grant of licenses to use the invention, will depend upon his power to keep the invention secret, and to benefit himself by the sale of the product of the machine.

There are many inventions to which the inventor, for various reasons connected with his regular business, cannot devote the time requisite for bringing them into operation; but he would risk a small sum for a patent if the invention afforded him reasonable hopes of remuneration by the sale of it.

If a man have a number of inventions, and if patents were cheap, he would take out a patent for each, giving to it a clear and definite title; whereas, under the present expense of patents, that cannot be afforded: and persons frequently wait till they have made several inventions, and then, that one patent may cover them all, they make out a very sweeping title. Thus the public is often deprived of the benefit of inventions for years.

An inventor often discovers, after maturing his invention, that the title is not correctly applicable to it; and in such cases, if patents

were not expensive, a new patent would frequently be obtained with a title more appropriate.

The number of inventions imported would be more considerable if patents were cheap.

A patentee will often find it impossible to make a sufficient number of experiments to enable him to draw up a good and valid specification of his invention in time for enrolment to save his patent. In such a case, neglecting to give in any specification, he would, if he could obtain a patent for a small sum, take out a new one; unless in his former title he had already exposed too much of his invention.

Patents for Principles.

As the objects of granting patents are to benefit the public and to reward inventors, patents should be granted for all discoveries, of which the public had not any previous knowledge; for it is not reasonable to expect that persons will communicate their discoveries without some probability of being rewarded.

Many of the gentlemen who gave their evidence before the committee of the House of Commons, in the session, 1828, were of opinion that no patent ought to be granted for the discovery of a principle, unless the discoverer specified some mode of rendering the new principle useful to the public; and in that case, it may be presumed, they were of opinion that every application, of which the new principle should be found capable, ought to be secured to him, however inefficient his mode of applying it might be.

If such a plan is to be acted upon, it may require two distinct discoveries, the offspring of very different talent, to entitle to one patent. For instance,—a man may discover a new principle, yet, from the nature of his previous pursuits, he may be a very unlikely person to invent any apparatus, by which his new principle may be made useful to the public.

Before proceeding further, it may be proper to observe, that the word "principle," as applied to the arts, may be defined to mean any particular law or action of nature, by which two or more bodies influence each other, to produce some certain result; or, that particular kind of action by which any thing is characterized.

New principles may be discovered by persons who do not see any useful application of them; yet, as soon as they are made known, such application is quickly made by others.

If the discovery of the magnetic principle had not been communicated, the mariner's compass might never have been invented.

If the first person who discovered that steam is capable of exerting great expansive force had obtained a patent for that discovery, and thereby given publicity to the fact, it is probable that amongst the numbers who would have attempted to render such force available for useful purposes, some one would have been successful; and that the steam engine and many other inventions with which the force of steam is connected, would have been employed beneficially some centuries earlier.

Publication of Patents.

All specifications of patent inventions should be officially published at as early a period after they are lodged in the patent office as their nature will admit of, in some work to be established for that purpose, which should be published, say once or twice a month. The work might be designated "The Official Record of Patent Inventions."

The following reasons offer themselves in favour of such a mode of procedure:—

That patent inventions may be well advertised amongst the persons most interested in them.

As a trade may have a new direction given to it, or may be entirely destroyed by a new discovery or invention, extensive publication is desirable, that parties interested may regulate their future proceedings accordingly.

That parties interested may be well informed what the claims of a patentee are; and thus have an opportunity to set his patent aside if he be not fairly entitled to it.

From the claims of a patentee being extensively known, infringments would be more likely to be detected.

Much time would be saved which is at present devoted to the prosecution of supposed new inventions, but which have before been patented. There would also then be fewer instances than occur at present, of two or three patents being granted, at nearly the same time, for the same object.

Persons requiring office copies of specifications, for legal or other purposes, would be spared the great expense which is at present incurred; and much valuable time would be saved which is now spent in going to the office to examine specifications.

That patentees may not be injured by the destruction of their specifications, by fire or otherwise.

In specifying improvements it is generally necessary to specify the thing improved; consequently the readers of the "Official Record," would be made acquainted with the old machines, or other matters, as well as with the improvements.

Defective Specifications.

Much has been said before the Committee of the House of Commons, about defective specifications being lodged by patentees, who were desirous of concealing from the public the real nature of their discoveries.

With respect to *mechanical* inventions it does not seem probable that many persons will attempt such concealment, since the invention is of necessity exposed by the sale of the first machine.

In *chemical* discoveries, the case may be different; and if some mode of inducing a patentee to amend his defective specification could be devised, without introducing a greater evil than now exists from an occasional defective specification, perhaps it would be de-

sirable to adopt it But nothing would tend more to put a patentee on his guard against making a defective specification, of either a mechanical invention or chemical discovery, than the knowledge, that his own workmen or others may become aware of, and expose those defects, whenever his specification is published in the manner recommended.

On the comparative durability of Cast and Wrought Iron, when used on Rail-roads. Extracted from the new edition of Wood's Treatise on Rail-roads.

We now come to the question of comparative durability between cast and malleable iron rails. The introduction of the latter being comparatively recent, the opportunity to subject them to the test of experiment, has not existed sufficiently long to produce any very conclusive decision from that source: the opportunities of doing so, are also not numerous; and many people are more disposed to concur in, and yield to, the general or current opinion, than either to wait the result, or submit to the tedious operation of experiment. In this case, also, no experiment can be decisive unless acted upon for a number of years: we are, therefore, almost obliged to act upon speculative opinion, until sufficient time has elapsed to produce conclusive evidence in favour of either mode.

Independent of economical considerations with respect to the durability of wrought iron rails, their safety, compared with cast iron upon public lines of road, has already almost produced a general concurrence in their favour: and therefore, perhaps, the question of durability becomes of less importance. Still, as in some cases, where rapidity of transit is not necessary, relative economy may become an object; we shall therefore adduce such as our experience enables us, of the comparative durability of cast and wrought iron.

Experiments are going on at present, where both kinds of rails, accurately weighed are laid down, and subjected to the passage of the same quantity of traffic over them: the result of these, so far as they have gone, are in favour of wrought iron. In the operation of making the cast iron rails, the surface is partially case-hardened in the casting: this may be seen in all cast iron rails extending to a certain depth from the surface; any experiment showing the comparative wear, must, therefore, be continued until after the outer hardened surface be worn through; and it is presumed that sufficient time has not yet elapsed to furnish this. We have therefore been obliged to reject the data founded on this mode of experimenting, and shall give the result of a different sort of test, more severe, and which, it is trusted, will be deemed sufficiently approximate to justify its presentation to the reader.

Upon the Killingworth rail-way, we had originally common cast iron wheels upon the locomotive engines; about four years ago we adopted wrought iron tires; now, as we have in this way the relative wear of cast and wrought iron upon the wheels which run upon the

rails; and as the nature of the action will operate nearly alike, whether upon the surface of the rails, or of the wheels, we shall by that means have a pretty near approximation to the relative wear upon the rails. In this way, we have a considerably more severe test; as, if we take the quantity of traffic equal to 2000 tons passing along the rail-way daily, and suppose the carriages to convey 3 tons each, with 3 feet wheels, the relative wear of the wheels and rails are as 53 : 1 nearly.

The average wear of the cast iron wheels was above $\frac{1}{4}$ inch in 9 months; and with the wrought iron tire, the wear of one pair of wheels has been $\frac{1}{4}$ inch in 3 years, and with three other engines, $\frac{1}{5}$ inch in 12 months; making the wear at least as 5 to 1 in favour of wrought iron.* The actual wear of the rails will not be to the same extent as this, as the engine wheels sometimes slip round, or slide upon the rails in bad weather. The wear of the wheels of the common carriages will not be so much for the same reasons; but although it should be observed, that from this we ought not to deduce the actual duration of wrought iron rails, as, their surfaces being narrower than the wheels, the wear will be, perhaps, more than proportionably greater; yet the relative wear should, however, remain the same.

The very great difference of wear in the wheels, proves, beyond any doubt, that if rails of the proper degree of strength be used, the durability must be decidedly in favour of wrought iron rails; and we have before observed that practice has shown, that in rails properly manufactured, none of the exfoliation, lamination, or oxidation originally dreaded, exists.

The next inquiry is, whether the resistance is greater upon wrought than upon cast iron rails. As in the case of the cast iron, when first introduced, the wrought iron rails were made far too slight; and observation showed that to a certain extent, the resistance appeared greater than upon cast iron; and this, as may be supposed, was owing to the bending.

To ascertain if such was the fact, to what extent, and to what strain they could be subjected without increasing the resistance, the following experiments were made.

Two lengths of rails were laid down upon balks of wood, one of

* The following is a memorandum of the duration of wrought and cast iron rails on the Stockton and Darlington rail-way.

Malleable iron rails, 15 feet long, over which locomotive engines pass, weighing from 8 to 11 tons. Wagons and their loads, 4 tons each.

86,000 tons passed over in a year, exclusive of engines and wagons.

Weight of rail, 1 cwt. 26½ lbs.

Loss of weight in 12 months, 8 oz.

Cast iron rails, 4 feet long, over which wagons only pass, weighing 4 tons each when loaded.

86,000 tons passed over in a year, exclusive of wagons.

Weight of rail, 63 lbs.

Loss of weight in 12 months, 8 oz.

The loss of weight in malleable iron rails, when wagons ONLY passed over, was, in the same period, 8 ounces for 15 feet length—the same quantity of goods, 86,000 tons.

cast, and the other of malleable iron, both of which were taken off the rail-way in their working, and brightened state. They were laid down close to each other, upon the same balks, and a pair of wheels resting on one could be readily lifted upon the other: two wheels joined together by an axle, and taken from one of the carriages in use, were then placed upon one of the lengths, and loaded on the lower side of the rim with weights, that could be varied at pleasure: the wheels thus unequally loaded, became like a pendulum, by the centre of gravity being thrown near the periphery on one side; and they would of course only remain at rest, when the line of gravity passed through the centre of the axle joining the two wheels, and that point of the periphery resting on the rails: the wheels were then rolled along the rails, until the centre of gravity was several inches beyond the point of bearing, and when let go, it of course vibrated backwards and forwards, until the resistance of the periphery upon the rails brought it to rest.

This mode of experimenting was preferred to trying the relative resistance by carriages; as, in this way, there was no action except that of rolling; and by lifting the wheels alternately from one kind of rail to the other, without altering the weight, the comparison became very delicate. A scale was used to measure the extent of each vibration from the centre, and the observations made by a telescope: the number of oscillations were thus counted, while the extent of the vibrations were diminished each inch. Thus, at the commencement, the extent of the vibrations from the point of rest was 5 inches; and the wheels made 56 vibrations before this was diminished an inch, or until the extent of vibrations from the centre was 4 inches. The cast iron rails were 3 feet 9 inches long, and weighed 56 lbs.; section shown in Fig. III. Plate II. The wrought iron rails weighed 28 lbs. per yard, the bearings 3 feet apart; section same as experiment II. on the strength of rails.

	EXPERIMENT I.				EXPERIMENT II.			
	Weight of wheels, &c. 10 cwt.				Weight of wheels, &c. 20 cwt.			
	Cast iron Rails.		Wrought iron Rails.		Cast iron Rails.		Wrought iron Rails.	
Extent of Vibrations.	No. of vib.	No. of vib.	No. of vib.	No. of vib.	No. of vib.	No. of vib.	No. of vib.	No. of vib.
in. in.								
5 to 4	56	62	54	64	52	50	52	52
4 to 3	74	78	68	80	64	70	64	66
3 to 2	88	22	84	100	84	82	92	86
2 to 1	87	86	98	84	99	110	142	150

Extent of Vibrations.	EXPERIMENT III. Weight of wheels, &c. 30 cwt.					EXPERIMENT IV. Weight of wheels, &c. 40 cwt.					
	Cast iron Rails.		Wrought iron Rails.			Cast Iron Rails.		Wrought iron Rails.			
	No. of vib.	Wedged. No. of vib.	No. of vib.	No. of vib.	Wedged. No. of vib.	No. of vib.	Wedged. No. of vib.	No. of vib.	No. of vib.	Wedged. No. of vib.	Wedged. No. of vib.
in. to in.											
7 to 6	—	—	—	—	—	28	30	24	26	31	32
6 to 5	—	—	—	—	—	32	34	28	28	32	32
5 to 4	54	46	54	54	50	42	36	38	38	35	35
4 to 3	66	56	70	66	68	44	48	44	46	43	45
3 to 2	82	78	90	94	90	48	46	56	55	50	48
2 to 1	94	90	116	124	114	52	52	84	82	63	66

These experiments will show that the resistance was the same with malleable and cast iron rails, until the incumbent weight reached 30 cwt.; with 40 cwt. the number of vibrations from 7 inches to 3 inches, in cast iron, was 146; while upon wrought iron, it was 134 and 138 respectively; showing a trifling increase of resistance with that weight. The rails were then wedged up on the under side to prevent them from bending, when the number of vibrations of cast iron was 148; showing that scarcely any resistance was owing to the want of stiffness. With the wrought iron, the wedging had an increase of effect, and brought up the resistance nearly equal to that of cast iron; and thus proving, that when no bending takes place in the wrought iron, the resistance is precisely the same as with cast iron.

We, however, find by these experiments, that the rails of wrought iron, upon which these experiments were made, were only sufficient for carriages of four wheels, weighing three tons. The deflection with 30 cwt. was .032 inch, with 40 cwt. .043 inch; so that we find it will not be adviseable to use rails, the deflection of which, when loaded, amounts to .032 inch, especially when the rails are laid down of this strength; as when they become worn, the deflection being greater, an increase of resistance will take place. With carriages mounted upon springs, which yield to all the inequalities, and want of parallelism of the road, we may suppose the whole weight of the carriage divided equally upon the four wheels. But with carriages without springs, as before stated, the weight of the carriage very frequently rests upon two wheels only: and in practice, therefore, we must, with these kind of carriages, suppose the whole weight acting upon two wheels.

To ensure, therefore, no increase of resistance in the use of wrought iron rails, their rigidity should be such, as that, by carriages with springs, one-fourth; and by carriages without springs, one-half of the

weight will not cause a deflection in the middle of the rail equal to .032 parts of an inch.

And considering that, in the experiment, the weights were applied carefully upon the rail; and that in practice, the weight, especially in carriages without springs, will be occasionally imposed with great abruptness, it will always be adviseable, independent of making proper allowance for wear, to adopt rails of more than sufficient rigidity to resist any injurious deflection by the weight of the carriages. The tables of experiments on the rigidity of different sections of rails, will be useful in determining the proper strength for practice; both for single lengths, and with rails of several compartments in one length.

The experiments on the comparative resistance of cast and malleable iron rails, were made with the surfaces of the rails quite dry, and free from dust: to ascertain the increase of resistance by the occurrence of any extraneous matter on the rails, the surfaces were watered pretty freely. The number of vibrations, before attaining a state of rest when dry, was 540 and 570, respectively; and when watered, 375. Upon wrought iron rails, when dry, with a less extent of vibration, the number of oscillations was 404 and 412; while, when chalked, the number was 230. With cast iron, when oiled, under the same circumstances, the number was 290; and when still more copiously oiled, the number was reduced to 244.

The result of these experiments is, therefore, that no increase of resistance takes place upon wrought iron rails; and that the resistance is a minimum, when the rails are quite dry and free from any extraneous matter. [*Rep. Pat. Inv.*

On the tempering of Metallic Wires and springs for Chronometers, Watches, Musical Instruments, &c.

To the Editors of the London Journal of Arts, &c.

Gentlemen,—A course of experiments in which I have lately engaged myself, has drawn my attention to the subject of the "*spirit*," as workmen technically call it, of metallic springs. The connexion of this subject with various important branches of our arts may claim for it a small space of your valuable publication. In respect of the more important interests of navigation, as well as of numerous minor purposes, a few practical observations may prove serviceable, by extending the knowledge of the ramifications of science. Springs are made perfectly well for different objects, so far as the manufacturer is concerned,—but a more general information as to their different temper, and the principles of such difference may tend to the more correct and perfect adaptation of elastic substances to the required end of the workmen who use them.

I am indebted for much of the following information to an old French memoir, originally published in 1774, by M. Le Roy, pere, the celebrated watchmaker of Louis XV. Certain experiments in

acoustics have supplied me with proofs of his correctness, and with some generally useful memoranda.

A bar of steel or iron, after being sufficiently heated, or subjected to the action of fire, becomes successively yellow, violet, blue, gray and white. The variations in intensity of these colours will partly depend upon the state and quality of the metal operated upon. Although philosophers are agreed that all hard bodies are elastic, yet hardness does not constitute *the measure of elasticity*, for a glass ball is much more elastic than an equal globe of cast iron; but their difference of hardness is by no means proportioned to that of their elasticity. A Damascene, or Moorish sword blade, is more springy or elastic than another, which shall, notwithstanding, make an impression upon the edge of the former. Now, this difference arises from the varied mode of tempering the respective blades. The steel or iron, after each transition above noticed, is said by the French to become *revenu.*

M. Le Roy informs us that he took three wires of common steel, to which he suspended weights, and put them in pendulous motion. They did not maintain their vibrations beyond seven minutes. He then tempered them to the fourth or gray state; in this stage of *revenu* the same wires maintained the vibrations of their masses during the space of 50 minutes. A wire of cast steel, which maintained the vibrations of its suspended weight for 10 minutes, continued them after it had passed to full blue, (*gros bleu,*) an hour longer. From Dr. Thompson's published tables of Cohesion, we learn that the power, or force of cohesion of bar iron, is to that of cast iron nearly as 75 : 50; for to tear asunder rods of each species, an inch square at the base, it required 74,500 lbs. avoirdupois, to destroy the cohesion of the particles of the bar iron rod, and 50,100 lbs. to effect the breaking of the cast iron rod. The elasticity or *spirit* of tempered steel springs appears, therefore, to be in an inverse ratio to their power of cohesion. An untempered wire of a harpsichord, maintained its vibrations for 14 minutes; after being tempered to gray-white, it maintained its suspended weight in motion nearly an hour. A wire of cast steel was tempered to *gros bleu* and then was diminished, (i. e. untempered,) and polished, in which state it vibrated only 17 minutes, but upon the *revenu à gros bleu*, it vibrated 67 minutes. These general facts serve to show the great advantage of understanding the variations of tempering, as affecting the elasticity of springs, and their consequent fitness for any required purpose. Our author appears to have applied his knowledge to the formation of the best chronometer work of the period, in which art he gained a high reputation.

But mere soft metallic wires and springs without any temper, will not vibrate well, nor maintain for any great length of time a suspended pendulum bob in motion. A copper wire is unsuited for these purposes; a brass wire is suitable in proportion to the quantity of zinc in its composition, so that it does not exceed one-half; the usual proportion is four parts of copper to one of zinc. About two years after the publication, by M. Le Roy, of his experiments, Count

Bruhl, the ambassador from the court of Dresden to St. James's, and M. Phillidor, had several piano fortes made, and strung with wires tempered *gros bleu;* they were universally acknowledged by amateurs, and the Royal Academy of Paris, to be superior in tone to instruments chorded with the usual steel wire. The progress which is making in the general application of scientific principles to our various branches of manufacture, induces me to hope that these few reminiscences may prove useful to some of our artists and operatives.

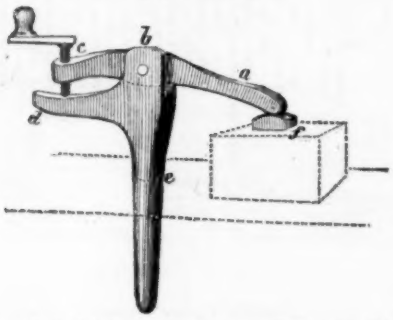
[*Lond. Jour.*

Hold-fast for Carpenters.

From the Transactions of the Society of Arts.

The common carpenter's hold-fast is a round bar of iron, thickening a little upward, and bent at the upper end almost into a right angle and flattened. An oblique hole is bored in the bench; and if a piece of wood, or any other article is wanted to be secured, it is placed under the hold-fast, and a few strokes of a mallet are sufficient to make it bite firmly. In order to loosen it, nothing more is necessary than a blow of a hammer applied at the back, or lower end of the bar.

Dungey's Hold-fast.



In Mr. Dungey's hold-fast, the jaw, *a*, instead of being one piece with the rest of the bar, is moveable on the axis *b*, and is prolonged backwards. In this latter part is a hole for the reception of a cranked screw, *c*, which bears on a projection, *d*, of the main bar: *e* is the hole in the bench, and *f* is a flat square piece fixed by a loose joint to the jaw *a*, and therefore capable of bearing by its whole surface on any piece of work placed under it. By turning the screw *c* in one direction the work is held fast, and by turning in the other direction it is released. It is considered as likely to be of service to coachmakers, carvers, and chair and cabinet makers, as the pressure of it is under perfect regulation, and it is not liable to bruise the work which it is employed to hold.

Meteorological Observations for September, 1831.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Dew point	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches.	Inches.				Inches.	
	1	63°	76°	29.90	29.90	62	S.	Breeze.		Clear—cloudy.
	2	68	76	.80	.90	67	S.	Calm.		Overcast—cloudy.
	3	68	77	.80	.89	67	SW. S.	Moderate.		Cloudy day. Sh'r in night
⊗	4	63	67	.80	.96	54	NE.	Breeze.	.7	Cloudy—drizzling.
	5	63	75	.86	.93	55	W.	Moderate.		Cloudy—clear.
	6	62	75	.91	.93	61	NW.	Breeze.		Clear—overcast.
	7	61	76	30.00	30.00	57	SW.	Calm.		Clear—overcast.
	8	67	76	29.90	29.87	64	SW.	Breeze.		Cloudy—overcast.
	9	67	76	.74	.74	64	NW.	Moderate.		Cloudy—overcast.
	10	69	78	.75	.75	65	SW. W.	Calm.		Fog—clear.
	11	71	82	.80	.90	64	W. SW.	Breeze.		Clear day. Shwr in night.
	12	62	72	30.00	.98	46	NW.	do.	.5	Clear day.
	13	56	70	.03	30.04	50	W.	Moderate.		Clear day.
☽	14	56	70	29.95	29.92	54	S.	do.		Cloudy day.
	15	61	72	.86	.77	61	SE.	do.	.20	Cloudy—rain.
	16	56	63	30.00	.95	59	NW.	do.		Cloudy—rain Rain night.
	17	47	63	.05	30.03	52	N.	do.	.30	Cloudy—clear.
	18	47	69	.07	.05	46	NE.	do.		Clear day.
	19	47	69	29.98	29.95	45	NW. SW.	do.		Clear—overcast.
	20	49	73	.86	.83	50	W.	do.		Cloudy—clear.
	21	59	69	.90	.90	54	NE.	do.		Cloudy day.
	22	59	75	.83	.89	57	NE. SE.	Breeze.		Cl'dy—overcast. Rain n't
	23	58	68	.76	.70	67	S. NW.	Moderate.	.74	Showry—cloudy.
	24	55	68	.80	.90	45	NW. W.	do.		Clear day.
	25	55	69	.90	.96	55	NW. SW.	do.		Cl'r. cld'y: rain n't.
	26	63	71	.74	.74	62	NE.	do.	.62	Cloudy day.—rain night.
	27	61	55	.60	.55	60	NW. SW.	Breeze.	2.85	Cloudy day.
	28	51	63	.70	.70	45	W.	Blustering.		Cloudy—clear.
	29	49	64	.75	.72	49	W.	Moderate.		Clear—cloudy.
	30	44	63	.92	.94	42	NW. W.	do.		Clear day.
	Mean	59.50	71.10	29.86	29.86	56.1			4.93	

	Thermometer.		Barometer.	
Maximum height during the month,	83.	on 10th.	30.07	on 18th.
Minimum do.	44.	on 30th.	29.55	on 27th.
Mean do.	65.80		29.86	

Note to Subscribers.

Our subscribers are informed, that the delay in this number of the Journal, has been caused by the destruction of part of the printed sheets, in a fire which occurred at the printing office of the Journal.